Printed on Thin Paper for Foreign Circulation.

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CLIII.—No. 3966] LONDON: FRIDAY EVENING, JANUARY 15, 1932 [PRICE { WITH INDEX AND OTHER SUPPLEMENT } 1s. 6d. BY INLAND POST 1s. 9d.

PUBLIC NOTICES.

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 29th January, 1932, for LOW-PRESSURE HOT WATER HEATING at the Registrar-General's Department, Somerset-house, W.C.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities, and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 8022

London County Council.

TENDERS are INVITED for the INSTALLATION of STEAM PLANT, STEAM and CONDENSE MAINS, GAS, WATER and FIRE HYDRANT MAINS, FORCED CIRCULATION HEATING and HOT WATER SUPPLY APPARATUS and MAINS and MISCELLANEOUS WORK at St. Nicholas Hospital, Plumstead, S.E. 18.

Specification, form of Tender, &c., in respect of the above work may be obtained on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, on and after Wednesday, 13th January, 1932, upon payment of £1 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if a bona fide Tender is submitted and is not subsequently withdrawn. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur street, S.W.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the CLERK OF THE COUNCIL at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 15th February, 1932, will be considered.

The Council does not bind itself to accept the lowest or any Tender. 8018

The Trade Commissioner for MYSORE is prepared to receive TENDERS for the SUPPLY of :—

3 CHASSIS for RAIL CARS (Metre Gauge),
2 CHASSIS for RAIL CARS (2ft. 6in. Gauge),
1 CHASSIS for RAIL CAR (2ft. Gauge),

of Steam, Diesel-electric, Diesel-geared, Petrol, or any suitable type for light and fast passenger traffic, with capacity for 50 passengers.

Particulars, with Tender form, can be obtained from the Consulting Engineers, Messrs. RENDEL, PALMER and TRITTON, 55, Broadway, Westminster, S.W. 1, to whom Tenders are returnable by 5th February, 1932. 8023

Wellington (Salop) Urban DISTRICT COUNCIL.
NEW WATERWORKS.
CONTRACT C.

The above Council invite TENDERS from experienced Contractors for PROVIDING and LAYING approximately 7 MILES of 8in. and about 1 MILE of 6in., 4in., and 3in. Diameter CAST IRON PIPES; the CONSTRUCTION of a CONCRETE RESERVOIR of 800,000 gallons capacity with Reinforced Concrete Roof; a CONCRETE HIGH-LEVEL TANK of 30,000 gallons capacity; a SMALL PUMPING STATION; together with RAILWAY and CANAL CROSSING VALVES, and all ANCILLARY WORKS.

Form of Tender, general conditions, specification and schedule of quantities may be obtained from Edward Sandeman, M. Inst. C.E., Consulting Engineer to the Council, 15, Victoria-street, Westminster, S.W. 1 upon payment of a deposit of £5, which amount will be refunded on receipt of a bona fide Tender and the return of all documents.

The drawings can be inspected at the office of Mr. William Walker, Surveyor, Walker-steet, Wellington, or by appointment at the office of the Consulting Engineer, 15, Victoria-street, Westminster, S.W. 1.

Sealed Tenders, endorsed "Wellington (Salop) Water, Tender for Contract C," are to be delivered to the undersigned not later than Twelve Noon on Monday, 8th February, 1932.

The Council do not bind themselves to accept the lowest or any Tender.

GEOFFREY L. PEACE,
Clerk to the Council.

Bank Chambers,
Wellington, Shropshire.
9th January, 1932. 8019

The Engineers' Register of the JUNIOR INSTITUTION OF ENGINEERS, 39, VICTORIA-STREET, S.W. 1, licensed annually by the London County Council, contains the names and specialised experience of many Members, both Junior and Senior Men, who are available for service in administrative and technical capacities in all branches of engineering.

Employers seeking such men for service, either in Great Britain or abroad, are invited to address their inquiries to the SECRETARY. P1920

NOTICE TO FOREMEN.

The National Foremen's Asso- CIATION is an Association of Foremen formed to represent them on all questions affecting their supervisory interests.

For full particulars apply GENERAL SECRETARY, 95, Belgrave-road, Westminster, S.W. 1. 7968

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

JOURNALIST WANTED in London, with Expert knowledge of Coal Treatment and Power and Lighting Supply Questions. State experience, salary required and when free. Might consider part time.—Address, P1907, The Engineer Office. P1907 A

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

Gyro-Stabilisers for the "Conte di Savoia" No. II. (P. 62)
(With a Two-page Supplement).
THE ENGINEER, 15 - 1 - 32.

Propelling Machinery for the Mercantile Marine. (P. 74)
(STERRY B. FREEMAN.) THE ENGINEER, 15 - 1 - 32.

Science and Industry. (P. 73)
THE ENGINEER, 15 - 1 - 32.

Physical and Optical Societies' Exhibition No. II. (P. 68)
THE ENGINEER, 15 - 1 - 32.

Shipbuilding and Marine Engineering in 1931 No. III. (P. 77)
THE ENGINEER, 15 - 1 - 32.

Scientific and Industrial Research. (P. 78)
THE ENGINEER, 15 - 1 - 32.

Water Supply in 1931—No. II. (P. 67)
THE ENGINEER, 15 - 1 - 32.

Index to Vol. CLII.
THE ENGINEER, 15 - 1 - 32.

INDEX TO ADVERTISEMENTS, PAGE 61.

SITUATIONS OPEN.

WANTED, PNEUMATIC TOOL DESIGNER.—The SERVICES of a First-class DESIGNER are REQUIRED.—Only those accustomed to this class of work need apply, stating experience and salary required, to Box ZB. 333, c/o Deacon's Advertising Offices, Fenchurch-avenue, E.C. 3. 8029 A

CRANE FIRM in North of England REQUIRES TRAINED ENGINEER as TRAVELLER.

Applicants must have had previous experience of Salesmanship in Crane Work. Good education and ability to secure orders essential.

Address, giving particulars of career, age and salary required, 8026, The Engineer Office. 8026 A

MANAGER for Coal and Other Materials Handling and Shipping Plant. Applicant must have good personality, adequate knowledge of Modern Design, Manufacture and Erection. Good connection and knowledge of market essential. State age, experience and salary required.

Address, 7997, The Engineer Office. 7997 A

WORKS MANAGER.—Would Suitable Candidates for such post PLEASE REFER TO ADVERTISEMENT in this issue commencing "General Foreman." P1909 A

CEMENT WORKS DRAUGHTSMAN WANTED AT ONCE, with good experience of both General Arrangements and Details.—Address, stating age, experience, and salary required, 8025, The Engineer Office. 8025 A

DRAUGHTSMAN, Trained and Experienced in Reciprocating Waterworks Pumping Machinery and Pumps. Details with age and salary required.—Address, 8021, The Engineer Office. 8021 A

GENERAL FOREMAN REQUIRED Shortly, with first-class knowledge of Machine Shop Procedure, for small progressive shop engaged on non-repetition work in London district. Applicants should state ALL the following, with dates:—(1) Age, (2) education, (3) training, (4) positions held, (5) relevant personal details, (6) salary suggested to commence, as at end of six months a suitable man would be made works manager permanently, with salary increase, if of proved energy, ability and integrity.

Applicants are requested to write at length, as all letters will be fully considered, and to state hours when free for interview.

Address, P1908, The Engineer Office. P1908 A

MACHINE and FITTING SHOP FOREMAN WANTED by General Engineers, South of England; used to Government work. State age, experience and salary required.—Address, P1929, The Engineer Office. P1929 A

SITUATIONS OPEN.

GENERAL WORKS FOREMAN REQUIRED for Aluminium Hollow-ware Factory, to Take Charge over Departmental Foreman. Must have had good experience and be capable of running departments on economical lines. This is a good progressive opening for a capable man with organising ability and knowledge of piecework rates.—Address, giving full particulars, age, experience, and salary expected, which will be treated in confidence, P1913, The Engineer Office. P1913 A

SITUATIONS WANTED.

ASSISTANT ENGINEER or DRAUGHTSMAN; exp. in marine and constructional, laying off, survey, oil refinery in all dept., dry blast, air conditioning and heating, &c.; Kent County Advanced Certificates in Engineering. Good references; any capacity. Age 32 years.—Address, P1916, The Engineer Office. P1916 B

CIVIL and MECHL. ENGINEER (38), University training, A.M. Inst. C.E., &c., 20 years' exp., works and D.O., structural steel, R.I.C. construction, plant and buildings, roads, drains, sea defence, bridges, &c., recently acts. res. engineer, F.W.D., REQUIRES POSITION, home or abroad.—Address, P1887, The Engineer Office. P1887 B

CIVIL ENGINEER (29), B.Sc., IMMEDIATELY AVAILABLE for EMPLOYMENT anywhere, over seven years' experience on construction at home and abroad, mostly on large works; engineering survey experience in Spain. Good references.—Address, P1902, The Engineer Office. P1902 B

CIVIL ENGINEER (39) SEEKS APPOINTMENT, home or abroad. Free Jan. Experienced roads, bridges, hydro-electric, sewerage, piling and cofferdams. Able designer reinforced concrete. Moderate salary.—Address, P1862, The Engineer Office. P1862 B

ELECTRICAL ENGINEER (29), Unmarried, DESIRES progressive POSITION abroad. Sound technical and practical ability, seven years' versatile experience in the East of construction and maintenance large transmission and distribution systems, complete motor and switchgear installations for workshops and petroleum refining plants, overhead line construction in exacting conditions, intimate knowledge of economics, supervision of labour, &c.—Address, P1917, The Engineer Office. P1917 B

ENGINEER, A.M.I.M.E., with Connection in South Wales, collieries, steel and tin-plate works, is PREPARED to REPRESENT a COMPANY desirous of extending activities in this area.—Address, P1919, The Engineer Office. P1919 B

SITUATIONS WANTED (continued)

ENGINEER, B.O.T. 1st Class, REQUIRES SITUATION, home or abroad. Varied experience in harbour and mineral dredging, bucket and suction, maintenance of harbour craft, hoppers, tugs and installation of gravel pumps, hydraulic elevators, &c.—Address, P1924, The Engineer Office. P1924 B

ENGINEER (47), DESIRES ADMINISTRATIVE POSITION or one of trust. Just completed large reconstruction contract; cement works, collieries; works, drawing-office, management, consulting and administrative experience.—Address, P1932, The Engineer Office. P1932 B

ENGINEER (32), First-class B.O.T. Certificate, present acting engineer and manager manufacturing concern, DESIRES MORE PROGRESSIVE APPOINTMENT. Sound business experience, excellent connections, shipping and industrial firms; South Wales.—Address, P1933, The Engineer Office. P1933 B

ENGINEER, Just Finished Apprenticeship with firm of repute, DESIRES progressive POST at home or abroad. Willing to go anywhere.—Box No. C571, c/o 19-21, Corporation-street, Birmingham. P1905 B

ENGINEER (27), General or Struct., Exp. Shops, D.O., estimating and design, erection, supervision, smithing, foundry work, steam-raising plant and pipe work, sound tech. knowledge, 3 years charge of works, 1 year outside representative, DESIRES progressive POSITION, home or abroad.
Address, P1914, The Engineer Office. P1914 B

ENGINEER (32) SEEKS APPOINTMENT. Exp. works design, erection and maintenance steel and rubber industries.
BM/L024, London, W.C. 1. P1912 B

ENGINEER (30), SEEKS EMPLOYMENT, any suitable capacity, civil or mech. Degree, exp. shops, D.O., construction, erection, surveying, steel-work, reinf. con., machinery, &c.—Address, P1884, The Engineer Office. P1884 B

ENGINEER, with Extensive Experience of All classes of compression-ignition oil engines, including latest applications to commercial vehicles, REQUIRES suitable POST at home or abroad. Design, manufacture, installation or maintenance.—Address, P1910, The Engineer Office. P1910 B

FRENCH GRADUATE ENGINEER, Aged 35, proprietor of empty warehouse suburbs Paris, WANTS SITUATION with British Export Firm or other undertaking in France.
LABORDE, 97 rue des Corisiers, Colombes (Seine), France. 8028 B

MECHANICAL ENGINEER, Six Years' Experience in power production, SEEKS POST at home or abroad. University degrees. Fluent French and German, some Spanish.—Replies to RM/IBEM, London, W.C. 1. P1922 B

MECHANICAL ENGINEER (31), Sound D.O. and test experience, economical works management, maintenance of boilers, steam and hydraulic plant, Diesel engines and specialised in use of oil fuel, DESIRES POSITION of TRUST.—Address, P1906, The Engineer Office. P1906 B

MECHANICAL ENGINEER (33), Single, 11 Years' experience abroad, 3 years works manager to motor concern, 5 years manager Government brick concern, 75,000 day capacity, run on commercial lines, later assist. mech. engineer, Government, capable to install, run and maintain any class mechanical plant, able to handle labour efficiently and produce results, will ACCEPT APPOINTMENT, home or abroad.—Address, P1915, The Engineer Office. P1915 B

MECH. ENGINEER (24), 6 Years Pupil Loco. Eng., D.O. and works, subsequent exp. in steam engines, pumps, &c., excellent machine shop exp. Moderate salary.—Address, P1923, The Engineer Office. P1923 B

MECHANICAL ENGINEER (26) WISHES APPOINTMENT ABROAD. Four years workshop, 2½ years D.O., three years maintenance in India. Tech. College, steam and oil engines, waterworks, structural, and general engineering. Excellent references.—Address, P1898, The Engineer Office. P1898 B

S. H. GIBSON, Late Central Engineer to Manchester Collieries, Ltd., and previously Chief Mechanical Engineer to the Clifton and Kersley Coal Co., DESIRES POST.—Address, Vale Bank, Clifton, near Manchester. P1873 B

STRUCTURAL and MECHANICAL ENGINEER (34), University education, 14 yrs.' D.O. and practical experience; heavy steel work, tanks; water, steam and oil piping, valve design, gearing; ventilation arrgts. Expert draughtsman.—Address, P1925, The Engineer Office. P1925 B

STRUCTURAL ENGINEER DESIRES ENGAGEMENT. Extensive experience in England and abroad. Thoroughly conversant with modern Practice in design and construction of steel and reinforced concrete work for industrial and architectural buildings. Would accept Temporary Offer. Highest references.—Address, P1885, The Engineer Office. P1885 B

SITUATIONS WANTED (continued)

Page 2.
AUCTIONS, Page 62.
PATENTS, Page 62.
MACHINERY, &c., WANTED, Page 62.
EDUCATIONAL, Page 2.
PARTNERSHIPS, Page 2.
FOR HIRE, Page 2.
AGENCIES, Page 2.
MISCELLANEOUS, Page 62
FOR SALE, Page 62.
WORK WANTED, Page 62.

For Advertisement Rates see First Column Overleaf.

The Engineer

Annual Subscription Rates

(including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below :—

BRITISH ISLES ..	£3	5	0	
CANADA	£3	3	0	Thick Paper Ed.
	£2	18	6	Thin Paper Ed.
ABROAD	£3	7	6	Thick Paper Ed.
(except Canada)	£3	3	0	Thin Paper Ed.

AFRICA	Central News Agency. All Branches
* £3 7s. 6d.	CAPE TOWN : Wm. Dawson and
† £3 3s. 0d.	Sons, Ltd., 29–31, Long-street (Box 489)
	JOHANNESBURG : C. Juta and Co.
ARGENTINE ..	BUENOS AIRES : Mitchell's Book
* £3 7s. 6d.	Store, 576, Cangallo
† £3 3s. 0d.	
AUSTRALIA ..	Gordon and Gotch (Australasia),
* £3 7s. 6d.	Ltd. All Branches
† £3 3s. 0d.	MELBOURNE : Robertson and Mullens, Elizabeth-street
BELGIUM ..	BRUXELLES : E. Graddon, 78, Rue
* Fr. 500	du Marché-aux-Herbes
† Fr. 550	BRUXELLES : W. H. Smith and Son, 78–80, Rue du Marché-aux-Herbes
CANADA	American News Company, Ltd. All
* $15·25	Branches
† $14·25	MONTREAL : Gordon and Gotch, Ltd., 334, Notre Dame-street, W.
	TORONTO : Wm. Dawson and Sons, Ltd., 87, Queen-street East
	TORONTO : Gordon and Gotch, Ltd., 51, Queen-street West
CEYLON	COLOMBO : Wijayartna and Co.
* Rs. 44·5	
† Rs. 41·5	
CHINA	HONG KONG : Kelly and Walsh,
* $37	Ltd.
† $34·5	SHANGHAI : Kelly and Walsh, Ltd.
EGYPT	CAIRO : Express Book and
* £3 7s. 6d. (Pt. 330)	Stationery Store, 9, Chareh
† £3 3s. 0d. (Pt. 308)	Maghrabi
FINLAND ..	HELSINGFORS : Akademiska Bok-
* M. 650	handeln, Alexandersgatan, 7
† M. 605	
FRANCE	PARIS : Boyveau and Chevillet, Rue
* Fr. 418	de la Banque, 22
† Fr. 390	PARIS : Librarie Berger-Leverault, 229, Bld. St. Germain
	PARIS : Brentano's, 37, Av. de l'Opera
	PARIS : Dunod, 92, Rue Bonaparte
	PARIS : W. H. Smith and Son, 248, Rue de Rivoli
GERMANY ..	BERLIN - LICHTERFELDE - WEST :
* R. mks. 70·00	H. Hermanns, Dahlemer Strasse,
† R. mks. 65·00	64 A
	LEIPZIG : K. W. Hiersemaan, Konigstrasse 29
HOLLAND ..	ROTTERDAM : Hector's Boek-
* Fl. 41·00	handel, Noordblaak 59
† Fl. 38·00	ROTTERDAM : Techn. Boekhandel, "Plan C," Gelderschestraat 4
INDIA	BOMBAY : Thacker and Co., Ltd.
* Rs. 45	CALCUTTA : Thacker, Spink and Co.
† Rs. 42	
ITALY	MILAN : Ulrico Hoepli
* Lire 300	ROME : Maglioni and Strini, 307,
† Lire 280	Corso
	ROME : Fratelli Treves, Corso Umberto 1, 174
	ROME : Fratelli Bocca
	TURIN : Rosenberg and Sellier, v. Maria Vittoria 16, and their Branches at Naples and Rome
JAPAN	Maruzen Co. All Branches
* £3 7s. 6d.	
† £3 3s. 0d.	
JAMAICA	KINGSTON : Educational Supply
* £3 7s. 6d.	Co.
† £3 3s. 0d.	
NEW ZEALAND	AUCKLAND : Whitcombe and
* £3 7s. 6d.	Tombs, Ltd.
† £3 3s. 0d.	Gordon & Gotch, Ltd. All Branches
	NAPIER : J. Wilson Craig and Co.
RUSSIA	LENINGRAD : Meshdunarodnaya
* £3 7s. 6d.	Kniga, Prospect Volodarsky, 53A
† £3 3s. 0d.	MOSCOW : "Litisdat," Kousnet-sky Most, 515
STRAITS SETTLEMENTS	—SINGAPORE : Kelly and
* $29·25	Walsh, Ltd.
† $27·25	
SWEDEN	STOCKHOLM : A/B Wennergrens
* Kr. 61·00	Journal-expedition, Stockholm 1
† Kr. 57·00	STOCKHOLM : A/B C. E. Fritzes Kungl., Hofbokhandel, Fredsgatan, 2
SWITZERLAND	BERNE : Joh. William De Groot,
* Fr. 85·20	Laupenstr, 5
† Fr. 79·50	ZURICH : Rosa Leibowics, 4, Ankerstr.
UNITED STATES OF AMERICA	International News Co., 131, Varick-street, New York, N.Y., and all Branches
* $16·40	Entered as second-class matter at the Post
† $15·25	Office, New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.)

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 28, Essex Street, Strand, London, W.C. 2. Teleg. Address, "Engineer Newspaper, Estrand, London." Tel.: Central 6565 (8 Lines).

SITUATIONS WANTED (continued)

DRAUGHTSMAN (29) or ASSISTANT ENGINEER. 5 years shops, 8 years D.O., thorough mech. experience; fluent German, mod. salary; go abroad. —Address, P1934, The Engineer Office. P1934 B

JNR. DRAUGHTSMAN, 18, SEEKS SIT., Engineers' drawing-office. Secondary education; 3 yrs. technical institute training, 2 yrs. works.—Address, P1926, The Engineer Office. P1926 B

FOREMAN BLACKSMITH, Eng. Fully qualified all branches trade. Last 10 yrs. Indian. rly. work. Mech. Eng. (Shops Practice) Diploma. Aged 44; 1st class testimonials.—Address, P1927, The Engineer Office. P1927 B

ENGINEER'S FITTER and TURNER (30) REQUIRES Works Maintenance SITUATION. Over 7 years with previous employers, know. car repairs, 6 years' driving exp.—Address, P1918, The Engineer Office. P1918 B

AGENCIES.

AGENCIES Amongst Steam Users OFFERED for "Non-Incrusta," the Scale Remover and Metal Preserver. This is genuine. Commission basis. References exchanged.—WILSON, 18, John Gate, Bradford. P1928 D

COMPETENT TECHNICAL ENGINEER, in a position to influence immediate business, can TAKE UP ONE or TWO AGENCIES for Machine Tools, Small Tools, and Engineers' Equipment, in the London area, which will be actively worked.—Address, P1911, The Engineer Office. P1911 D

ENGINEERING FIRM of High Standing and reputation known throughout world, DESIRES ACT as ENGINEERS and PURCHASING AGENTS for important interests abroad. Maintains head office London, with highly technical and commercial personnel experienced latest practice in power, gas, oil refining, hydraulic, railway, chemical, coal-handling, mining and civil engineering; conversant British and Continental manufacturing and market conditions, and thoroughly understand co-operation with concerns abroad and efficient handling overseas business. Address, 8027, The Engineer Office. 8027 D

LONDON : ENGINEER, with Extensive Business experience, office, and highest credentials, is OPEN to REPRESENT on agreeable terms.—Address, P1935, The Engineer Office. P1935 D

EDUCATIONAL

Correspondence Courses
OF
PREPARATION
FOR THE
Examinations
OF THE
INST. OF CIVIL ENGINEERS,
INST. OF MECHANICAL ENGRS.,
INST. OF STRUCTURAL ENGRS.,
UNIVERSITY OF LONDON, &c.,
ARE PERSONALLY CONDUCTED BY
Mr. Trevor W. Phillips,
B.Sc., Honours, Engineering, London University, Assoc. M. Inst. C.E., A.M.I. Struct. E., M.R.S.I., F.R.S.A., Chartered Civil Engineer, &c.,
For full particulars and advice apply to :—
36, DALE STREET, LIVERPOOL.
LONDON OFFICE :—65, CHANCERY LANE, W.C. 2.

T.I.G.B.
CORRESPONDENCE COURSES
FOR THE
PROFESSIONAL EXAMINATIONS
A.M. Inst. C.E., A.M.I. Mech. E., Grad. I.E.E., A.F.R.Ae.S., etc.

Convincing proof that The T.I.G.B. training is markedly successful is found in the many pages of "The Engineer's Guide to Success" which are filled with hundreds of typical results of T.I.G.B. Students.

Write to-day for "The Engineer's Guide to Success" — 140 pages — containing the widest selection of engineering courses in the world, and mention the branch, post or qualification that interests you. The T.I.G.B. guarantees training until successful for the one fee.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN,
76, Temple Bar House, London, E.C. 4.
(Founded 1917. 18,000 Successes.)

PARTNERSHIPS.

PARTNERSHIP. — Experienced MECHANICAL ENGINEER and DRAUGHTSMAN is PREPARED to TAKE ACTIVE PARTNERSHIP in any sound business. Invest £300-£500.—Address, P1921, The Engineer Office. P1921 C

FOR HIRE.

RICHD. D. BATCHELOR, ARTESIAN WELL ENGINEER (WATER SUPPLIES EXPERT). Largest Boring, Sinking and Pumping Plant. GRAVESEND CORPORATION TESTED TWO BORINGS to 14,000,000 GALLONS PER DAY (OUR GUARANTEE to 7,000,000). 73, Queen Victoria-street, E.C. 4, and Chatham. 'Phones : Central 4906 ; Chatham 2071. Wires : Boreholes, London ; Watershed, Chatham. ESTAB. OVER 150 YEARS.

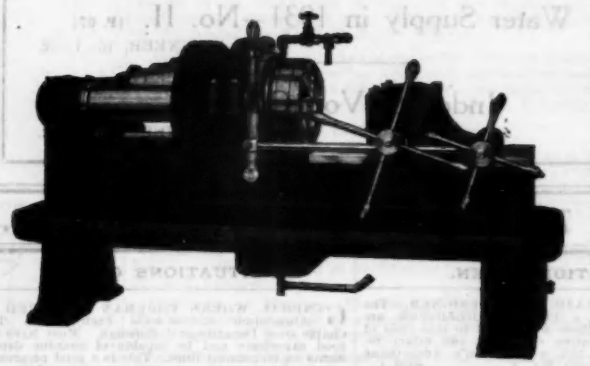
CLASSIFIED ADVERTISEMENTS

If you have a VACANCY *to fill,*
If you require a SITUATION,
If you want a MACHINE,
FACTORY PREMISES,
A CONTRACT,
AN AGENT,
A PARTNER, Etc.,
THEN STUDY AND MAKE USE OF THE
CLASSIFIED ADVERTISEMENT SECTION IN
The Engineer

YOUR ADVT. WILL BE SEEN BY ALL THOSE INTERESTED.

Heap's Patent Screwing Machines
with Tangential Dies.

Dies with Ground Threads for Precision Work.



They are designed from beginning to end as high-class Machine Tools and embody features not found in any other make of Screwing Machine.

The Die Head is of our own Patented design.

All parts of the Head, and also of the Die Holders which are liable to wear, are of Hardened Steel.

The thrust of the Dies is taken on the four-throw Cam which is fitted with Hardened Steel Strips.

The wall of metal which surrounds the Die Holders solidly supports them, and also eliminates the danger of the Operator being caught by protruding Die Holders.

The Hardened Steel Contact Blocks of the Die Holders bear for their full width on the Cams.

These features render the Die Head when closed as rigid as a solid Die and enable us to guarantee it to screw perfectly parallel and uniform threads.

Catalogue free on request.

Joshua Heap & Co., Ltd.
ASHTON-UNDER-LYNE, ENGLAND.

A UNIQUE OPPORTUNITY
to acquire at
PRE WAR RENT

Modern Premises of Dignity and Character

Situated at the CORNER of NORFOLK and HOWARD STREETS, One Block from
TEMPLE STATION,
Strand, London, W.C.2.

Five Stories and Basement, Main and Goods Entrance, Electric Lift, Strong Rooms, House Telephone Installation throughout. The whole in first-class condition.

TOTAL AREA - 8,200 Sq. Ft.
OFFICE FLOOR SPACE - 6,800 Sq. Ft.
23 YEARS LEASE.

Floors will be Let according to Tenants' Requirements
Rents from £250 per annum.

NO PREMIUM. IMMEDIATE POSSESSION.

For further particulars and order to view, apply to:
The Secretary, MORGAN BROS. (PUBLISHERS) LTD., 28, Essex Street, Strand, London, W.C.2.

A Seven-Day Journal

The Thames Conservancy Board.

A REVIEW of the work of the Thames Conservancy Board was presented by Lord Desborough at a meeting of the Board last Monday. The coming into force during the year of the Land Drainage Act, which gave the County and County Borough Councils an increased proportion of representation on the Board, had, he said, also slightly increased its land drainage powers to a catchment area determined by an official map of 3845 square miles. The increase was 21 square miles. A very large addition of water came under the jurisdiction of the Board, which now controlled 488 miles of waterways, the Thames contributing 137 miles and its tributaries and other watercourses 351 miles. The rainfall throughout the year had been 0·74in. in excess of the average, the great excess being in the summer months, whilst the winter months had a correspondingly low record. The rainfall in the Thames catchment area averaged 28·98in. There had not been at any time any floods, the highest flow recorded at Teddington being 4264 million gallons. Applications had been made by the Central Electricity Board for permission to carry high-tension electric wires over the rivers, and as regards 132,000-volt lines, the Conservators had consented, without prejudice, subject to agreed conditions. Applications for the reduction of charges for registration and lock tolls had been considered, but the Board had come to the conclusion that in view of its present and future commitments, no reductions could be made. After a conference with local authorities, the Board had agreed to contribute £200 of the total cost of £1500 for the clearing of 21 miles of channel of the river Blackwater. Merchandise traffic on the waters within the jurisdiction of the Board had amounted during the year to 330,296 tons, as compared with 372,808 tons in the preceding year.

The Late Sir Harry Renwick.

THE death of Sir Harry Renwick, which occurred on Thursday, January 7th, removes a well-known and enthusiastic worker from the electrical industry. He was a pioneer in the development of electricity supplies from super-power stations, and as chairman and managing director of the County of London Electricity Supply Company and a large number of associated companies, he was naturally closely associated with the power station at Barking, which was opened by the King in 1925. During the war he was Director of Feeding-stuffs at the Ministry of Food, and was a member of several Government Committees. He was Vice-president of the Federation of British Industries, and a member of the London and Home Counties Joint Electricity Authority. From 1909 onwards he was concerned in a large number of Bills before Parliament affecting the electrical industry, and in this connection he founded the Provincial Electric Supply Association, of which he became Chairman. Sir Harry, who was seventy-two years of age, is being succeeded by his son, Mr. Robert Burnham Renwick, as chairman of the County of London Electricity Supply Company.

Handcraft.

BEFORE a meeting of the Institute of Handcraft Teachers and the Educational Handwork Association at the Conference of Educational Associations, held at University College, London, Sir Ernest Graham-Little, in the course of a lecture upon "The Educational Importance of Craftsmanship," said that although the educational value of eye, hand, and brain by a manual craft was in many ways the best kind of education for the largest number of pupils, the neglect of such teaching was nearly complete in the schools. After discussing the value of such training and the ages at which children could be taught a handcraft, he went on to show that the provision of adequate teaching must be expensive, and he had some criticisms to make of the present educational system. Later, he added that it was a matter for regret that the English people, who enjoyed so high a reputation for craftsmanship when craftsmanship was general, as, for example, in the thirteenth century, would seem largely to have abdicated their position of pre-eminence. There might yet be a return to the more selective craftsmanship of the past if a certain school of economics was right and the cause of the modern world depression over-production. It was, however, consoling to find that Englishmen still retained a certain leadership in products of the finest craftsmanship, such as motor cars, aeroplanes, guns, watches, and scientific instruments.

The Birthday of the Metropolitan Railway.

As long ago as January 10th, 1863, the first public train travelled along the new underground railway, the first undertaking of its kind in the world. The Metropolitan, as first opened to the public, extended from Bishop's-road Station at Paddington to Farringdon-street. The difficulty of working such a railway when electricity was not available was the subject of much discussion. The employment of the atmospheric principle was not favoured, and it was believed that by the construction of condensing locomotives the difficulties had been overcome. The popularity of the line was, however, completely unexpected. The locomotives were designed to condense all their own steam when drawing three or four carriages, but owing to the numbers that wished to travel on the new railway it was found necessary to make the trains longer, and in consequence the load on the locomotives greater. The result was that the condensers fitted were inadequate and steam and smoke were blown into the tunnel to the great inconvenience of all concerned. So bad were the conditions that a correspondent in our issue of January 16th, 1863, gave it as his opinion that the line would eventually have to be worked on the atmospheric system, if it was to be a profitable undertaking. The line was originally worked by the Great Western Railway, and, like that line at that date, it was built on the broad gauge. The trouble with locomotives and condensers continued until 1904, when the change-over from steam to electricity solved the problem of ridding the tunnels of smoke and dirt.

A Defence of the Tramcar.

IN a communication sent by the Municipal Tramways and Transport Association to the Minister of Transport, protests are made against statements to be found in the final report of the Royal Commission on Transport. It will be remembered that the Commission regarded tramways as being in a state of obsolescence and suggested that they should gradually be allowed to give way to other forms of transport. The tramway was regarded as the direct cause of many accidents, especially as the result of setting down and picking up passengers in the middle of the street. The Commission also referred to the obligation of tramway companies towards road maintenance, but pointed out that taxation of each vehicle at 15s. compared with £96 for similar motor vehicles on pneumatic tires. The Municipal Tramways and Transport Association states that there appears to be no evidence that the tramway is the cause of much danger. On the contrary, annual returns published by the Home Office from statistics compiled by the police show that the tramcar is and has been the safest vehicle on the road. At December, 1930, states the Association, there were 13,700 tramcars and 2,246,800 other vehicles licensed. These 13,700 tramcars still bear the cost of maintaining a large proportion of the 2420 miles of roads with tramways. The position is considered inequitable and contrary to every tenet of taxation in this country.

The Lloyd Barrage on the Indus.

ON Wednesday last, January 13th, Lord Willingdon, the Viceroy of India, formally opened the Lloyd Barrage on the river Indus and the system of canals which it feeds. As is well known, the Indus is greatly subject to floods. While, at times, it is a raging torrent, it may, at others, die down to a comparatively small stream. Moreover, it is impossible to forecast with any certainty the arrival of floods. The province of Sind depends entirely for its fertility upon its flow, and, in the past, there have been periods during which the river has been too low to furnish sufficient water for adequate irrigation, with the result that many millions of acres of crops have withered and died. The purpose of the barrage just opened is to maintain the level of the water at such a height that satisfactory irrigation at all necessary seasons is assured. The barrage, which is just over a mile in length, has in it sixty-six openings, each 60ft. wide, which can be regulated by means of steel gates. Traversing the length of the structure are two roads, from the upper of which the gates can be manipulated, while the lower serves for the passage of traffic. Controlled by the barrage there are seven main canals, three on the right bank of the river and four on the left. These main canals vary in length from 13 to 525 miles, their combined extent amounting to some 1040 miles, and there are branches, distributors, and other watercourses which run to many thousand more miles in length. The aggregate final area of annual irrigation which will be made available is no less than 5,300,000 acres.

A New Sewage Pumping Station at Acton.

THE formal opening of a new sewage pumping station at Warple Way, The Vale, Acton, which is destined to raise the sewage from the low-level area of the town, took place on Saturday last, January 9th. The area concerned comprises the whole of Bedford Park and adjoining parts of the borough. The new plant, which replaces pumps that had been in service for some twenty-five years and were no longer capable of coping with the flow of sewage, comprises five sets of pumps driven by heavy-oil engines. Two of the sets, which are operated by 55 H.P. engines and are each designed to lift 2500 gallons per minute, will deal with the ordinary dry weather flow, while the other three sets, which will only be operated during times of rainfall, are driven by engines of 121, 232, and 340 horse-power, respectively, and are designed to pump 5500, 11,000, and 16,000 gallons per minute, respectively. The combined capacity of the whole of the plant, when all the units are in operation, simultaneously, is therefore 54,000,000 gallons per day. The sewage gravitates from different parts of the district to a sump adjoining the engine-house and is lifted by the pumps to a main outfall channel into which all the other sewers of the town discharge. The engines are started by compressed air, the compression being effected by independent engines in an adjoining room. The sewage, after leaving the rising mains in the building, passes through recording Venturi meters, so that an accurate account may be kept of the volume pumped.

The Late Sir William Mills.

SIR WILLIAM MILLS, whose death, we regret to have to record, occurred on Friday, January 8th, at Weston-super-Mare, will be remembered chiefly by the public as the inventor of the Mills bomb. His other achievements in peace-time engineering, however, were equally distinguished. He was born in 1856, and educated privately in Sunderland. Apprenticed with George Clark, Ltd., marine engineers, he afterwards went to sea and secured a First Engineer's Certificate. While at sea he gained considerable engineering experience, and was later responsible for many useful inventions, amongst which the Mills boat-disengaging gear, which brought him the prize of 100 guineas at the Royal Naval Exhibition, may be mentioned. He was an acknowledged pioneer of the aluminium industry in this country, did much experimental work in connection with its alloys, and established the first foundry for the metal in the United Kingdom. As might be expected from the pioneer of a new industry, he was granted several patents in connection with foundry work. Perhaps his greatest war services were the invention of the hand grenade which bears his name and his investigations into the causes of "prematures" and "blinds." During the war he established the Mills Munition Company to manufacture the grenade, besides other munitions of war. He was the proprietor of William Mills, Ltd., of Birmingham and Sunderland, chairman of the James Watt Memorial Trust, and a member of several engineering institutions. He was knighted in 1922.

The Future of Waterloo Bridge.

WE understand that the question of the future of Waterloo Bridge is now being considered by the London County Council and the Ministry of Transport. So far, it is understood, no definite plans have been formulated, and the discussion between the two bodies is in the nature of an exchange of views, with regard to the best steps which can be taken. The question of the participation in the cost of whatever scheme is eventually decided upon is also under review. At the time the question of the construction of a new bridge at Charing Cross was under consideration, it was anticipated that such a bridge, when built, would relieve the pressure of traffic over Waterloo Bridge, and since the rejection of the Charing Cross Bridge scheme, the consideration of the Waterloo Bridge position has become more important. The wooden supports have been in position for about seven years, and although careful watch over the bridge foundations is constantly exercised by the engineers of the London County Council, it is felt that the time is now ripe for a further consideration of the bridge's future.

Profit-Sharing in Co-operative Societies.

FIGURES issued recently by the Co-operative Productive Federation give details of the trading results and disposal of surpluses for 1930 of the co-operative productive societies associated with the Federation. In all, forty-one societies made returns, and of these, four have an engineering interest. As in previous years, Walsall Locks and Cart Gear, Ltd., headed the list in the metal-working and miscellaneous section, with sales totalling £77,861, a reduction of £61 when compared with the preceding year. This society had 343 members at the end of 1930 and a share and loan capital of £24,073. To its 339 employees it paid £37,267 in wages. The turnover resulted in a surplus of £2819, from which a bonus of £83 was given to the shareholders and £2063 to the workpeople; in addition, grants totalling £204 were made to educational and charitable purposes, the balance presumably being carried forward. The Chesham Builders, Ltd., with a membership of 42 and a share and loan capital of £821, did business to the extent of £10,711, compared with £9814 in 1929. Its surplus amounted to £258, and the only bonus given was the sum of £107 to labour. There was a wages bill of £4540 and 27 employees. The Alcester Needlemakers, Ltd., with 143 members and a share capital of £3344, paid £1111 in wages to its 10 workpeople. Its turnover amounted to £16,263, against £16,165 in 1929, giving a net surplus of £89. The remaining society in this section with which we are more particularly concerned is the Leicester Carriage Builders, Ltd. To its 1930 balance sheet it carried a loss of £672, and during the year reduced that deficit to £288. It had 181 members and a share and loan capital of £6614. At the end of the year it had 30 employees, its wages bill for the twelve months being £4205. The forty-one societies included in the Federation's statistics had a total membership of 14,966 and a share and loan capital of just over a million pounds. The number of employees at the end of 1930 was 6970, and the wages bill came out at £761,929.

The Gyroscopic Stabilising Equipment of the Lloyd Sabaudo Liner Conte di Savoia.

No. II. (*conclusion*).*

IN the preceding article we dealt with the theory and mode of operation of the Sperry system of gyroscopic stabilisation for ships. We now pass on to a description of some of the more important constructional features of the three-unit system for the new 45,000-ton Italian Transatlantic liner "Conte di Savoia." As already stated, the stabilising equipment has been made in this country under the supervision of the Sperry Gyroscope Company, Ltd., of Brentford, Middlesex, the mechanical portions having been supplied by Vickers-Armstrongs, Ltd., of Barrow, and the electrical portions by the Metropolitan-Vickers Electrical Company, Ltd., of Trafford Park. Throughout its construction the equipment has been under the inspection of Lloyds and the British Corporation.

On the constructional side chief interest will undoubtedly be felt in the fly-wheel. From the sectional drawing reproduced in the Supplement it will be seen that the fly-wheel is in the form of two recessed discs bolted together. The axle, in order to avoid weakening the discs by a central hole, is in two parts, which are studded to the fly-wheel boss. The discs and axles are made of forged low-carbon steel having a yield point of 37,000 lb. per square inch and a very high percentage of elongation and reduction of area. The fly-wheel was designed in accordance with Stodola's theory of the strength of turbine discs. According to that theory the maximum stress occurs in the webs and not in the rim. At 910 r.p.m., the highest working speed, the designed stress in the webs is 17,000 lb. per square inch in both the radial and tangential directions and is uniform at all radii. The factor of safety on the yield point is therefore 2·18.

In order to avoid distortion of the discs they are made to abut against each other only over a ring 6in. wide at the radius of the bolts. Elsewhere they stand clear of each other by about ¼in. The two discs are held against relative radial displacement by a series of curved keys constituting a ring. The bolts are therefore called upon to resist tension only. In order to ensure the uniform and correct tightening of the bolts they are drilled axially to permit an extensometer to be applied to them. The nuts are screwed up until each bolt exhibits a prescribed amount of extension. It will be noted that the recesses for the nuts are closed by caps held in place by small studs and that at the centre of each cap there is a small grub screw. These caps are provided for the purpose of restoring the plane face of the disc and thereby reducing the wind resistance losses. They also serve another purpose. During the balancing process they are removed as required and machined on their inner surface. The removal of metal from them in this way is employed for the preliminary or rough balancing of the wheel. The final balancing is effected by removing metal from the grub screws passing through the caps. It will be readily understood that the balancing of the wheel has to be carried out to a very fine degree. The precise method and the machine specially built for the purpose will, we hope, be the subject of a separate article in a future issue. For the time being it will perhaps suffice to say that after the final balancing the wheel is correctly balanced dynamically to within one-quarter of an ounce at the radius of the bolts, 64in. That achievement, when it is remembered that the wheel and its axle together weigh 110 tons, will be admitted to be a noteworthy development in the art of balancing rotating masses.

The axle is supported at each end in a spherically seated journal bearing heavily lined with babbit metal and deeply grooved for oil—see page 72. It has to be borne in mind that the stabilising forces applied at the precessional or athwartship journals originate in the fly-wheel and have therefore to be transmitted through the axle, the axle bearings and the casing. The axle bearings are therefore subjected to a heavy side load. The white metal with which they are lined is of sufficient thickness to accommodate without damage any deflection of the axle under the load which it has to transmit. At the lower end a Michell thrust bearing supports the weight of the fly-wheel. At the upper end an extension of the axle carries a roller bearing beneath which there is a hydraulic ram of annular formation. A hand-operated jack pump is provided on the side of the casing and from it oil can be pumped into the ram chamber in order that, at starting, the weight of the fly-wheel may be transferred off the lower Michell bearing on to the upper roller bearing. As the weight is lifted the movement effected by the hydraulic system is followed up and made good by means of a screwed collar beneath the roller bearing. This collar is rotated manually by aid of a pinion and gear. When the weight has been lifted in this way the fly-wheel is brought up to a speed of 100–200 r.p.m. The oil film having been formed in the Michell bearing, the weight of the fly-wheel can then safely be lowered on to it.

Immediately above the lower radial bearing the axle carries the rotor of the 560 horse-power squirrel-cage spinning motor. The stator is carried on a bracket inside the casing. The electrical connections are made through slip rings at one of the casing trunnions, the right-hand one, as seen in the cross section given in the Supplement. In some previous stabilisers the casing has been made air-tight in order that the fly-wheel might be run in a partial vacuum. In the present instance it was considered that at least as much power would be expended in maintaining the vacuum as would be saved at the spinning motor. At the highest working speed of 910 r.p.m. the fly-wheel has a peripheral velocity of 619·6ft. per second, or 422·5 miles an hour.† At such a speed the wind resistance experienced by the fly-wheel is considerable, so much so that unless precautions were taken to ventilate the casing the equipment would soon become overheated. Air enters the casing through a number of orifices surrounding the lower radial bearing, the draught being induced by a fan attached to the lower face of the rotor of the spinning motor. After passing through and over the rotor and stator of that motor the air is in part delivered through outlets in the casing just below the lower face of the fly-wheel. The rest of the air is delivered through a second fan at the top end of the rotor and is led by baffles against the lower face of the fly-wheel and upwards into the narrow clearance space between the fly-wheel periphery and the central cylindrical portion of the casing. From this clearance space it emerges through a row of circular breathers. Air also enters through holes in the upper conical portion of the casing and is partly ejected through a ring of holes just above the upper face of the fly-wheel and in part is deflected by baffles over the upper face and down into the peripheral clearance space, from which it finds its way outwards through a second set of breathers. After a continuous run of eighteen hours at 910 r.p.m. the casing at the time of our visit was exhibiting a steady external temperature of 80 deg. Fah.

One trunnion, as we have said, carries the slip rings for the electrical supply to the spinning motor. At the other, means are provided for the admission of oil to the fly-wheel bearings. The oil supply is derived from a pump driven by an independent motor. This pump is capable of circulating 250 gallons of oil per minute through the bearings. The normal working rate of circulation will be about 175 gallons per minute.

The casing is fabricated of flanged or otherwise wrought steel sheeting, and is built up partly by welding and partly by bolting and riveting. The circular precession rack is bolted to webs fixed to the side of the casing, and is enclosed by a stationary cover. Right at the top the casing carries a magneto counter for indicating the speed of the fly-wheel.

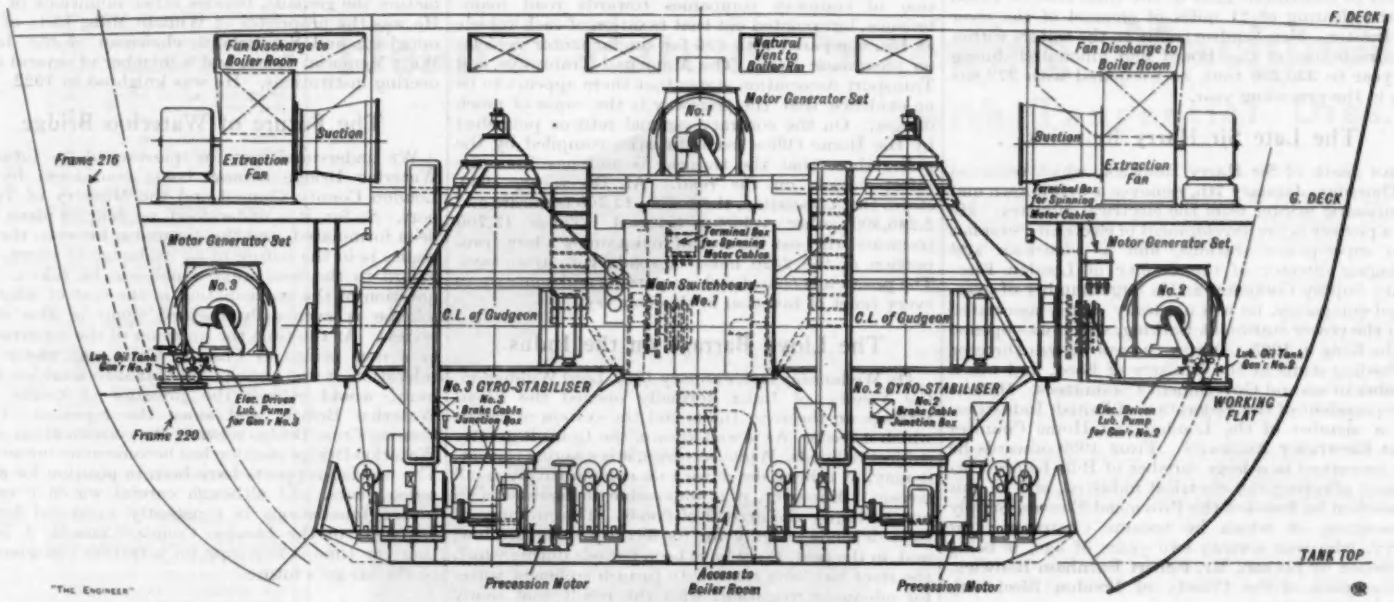
The equipment provided for precessing the gyroscope about the athwartship axis consists of a 100 H.P. direct-current motor, and three electro-magnetic brakes, all arranged coaxially athwart the ship. Two of the brakes are coupled directly to one end of the motor shaft. The other end of the motor shaft is connected through a flexible coupling with the shaft carrying the first pinion of the precession reduction gear train. Beyond this pinion comes the third electro-magnetic brake.

The precession motor, it is certain, will never be required to exercise its full power. The demand upon it cannot, however, be fixed with exactitude, and consequently the designers of the equipment have provided what is known to be a liberal margin. That margin has been increased by fitting the reduction gear train with roller bearings. The reduction gearing has teeth of the Vickers-Bramley-Bostock enveloping formation, and is kept liberally supplied with oil by means of a pump driven off the precession motor shafting.

The brake drums are water cooled. Each drum works in conjunction with two pairs of lined shoes, which are forced against the drum by means of two levers, and two helical springs. Provision is made for the hand adjustment of the strength of the springs, for the exact pressure which the shoes are required to exert against the drum can only be determined by experience and may require to be varied to give the best results under different conditions. Between the ends of the brake shoe levers there is placed the electro-magnet which, as previously explained, is energised to release the brakes simultaneously with the starting up of the precession motor. The electro-magnet is capable of exerting a very powerful thrust on the brake shoe levers. The thrust, we understand, is about 1 ton on each lever. Provision is made for adjusting the air gap of the electro-magnet in order that the desired floating action of the brakes may be secured.

As was remarked in our first article, the equipment is provided with stops which limit the angle of tilt of the gyroscope about the athwartship precessional axis. If one or other of these stops is struck, the energy in the rocking mass is absorbed, and thereafter a lock comes automatically into action and holds the gyroscope in its tilted position, until, after the reason for the striking of the stops has been investigated and rectified, the lock is released by hand. The stops have therefore to fulfil the combined functions of a buffer and a lock. Incidentally, they have to be fitted with an electrical cut-out switch, which will shut off current from the precession motor if the gyroscope becomes locked by either stop.

The design of the stops is illustrated in one of the

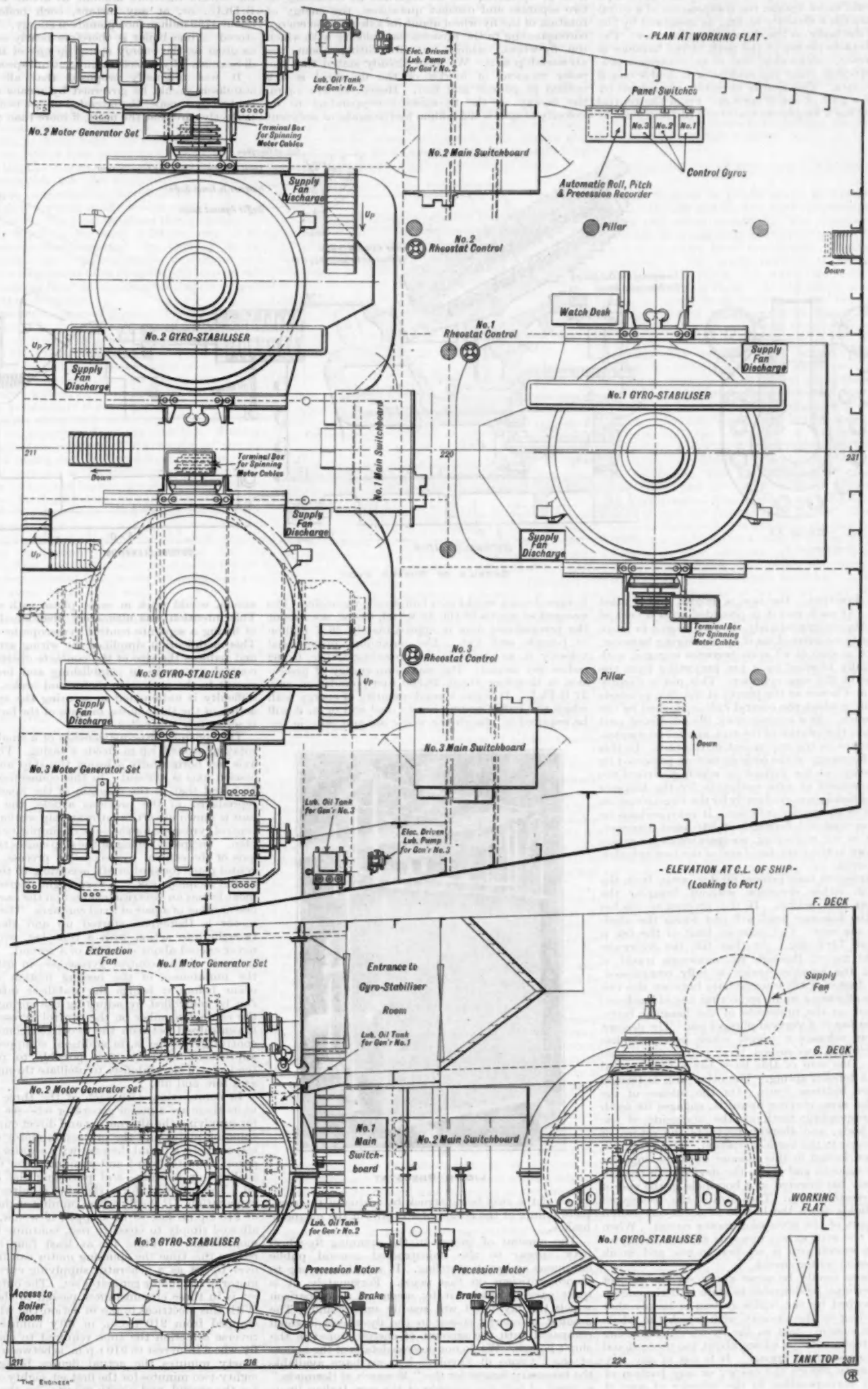


CROSS SECTION THROUGH STABILISER ROOM

* No. I. appeared January 8th.

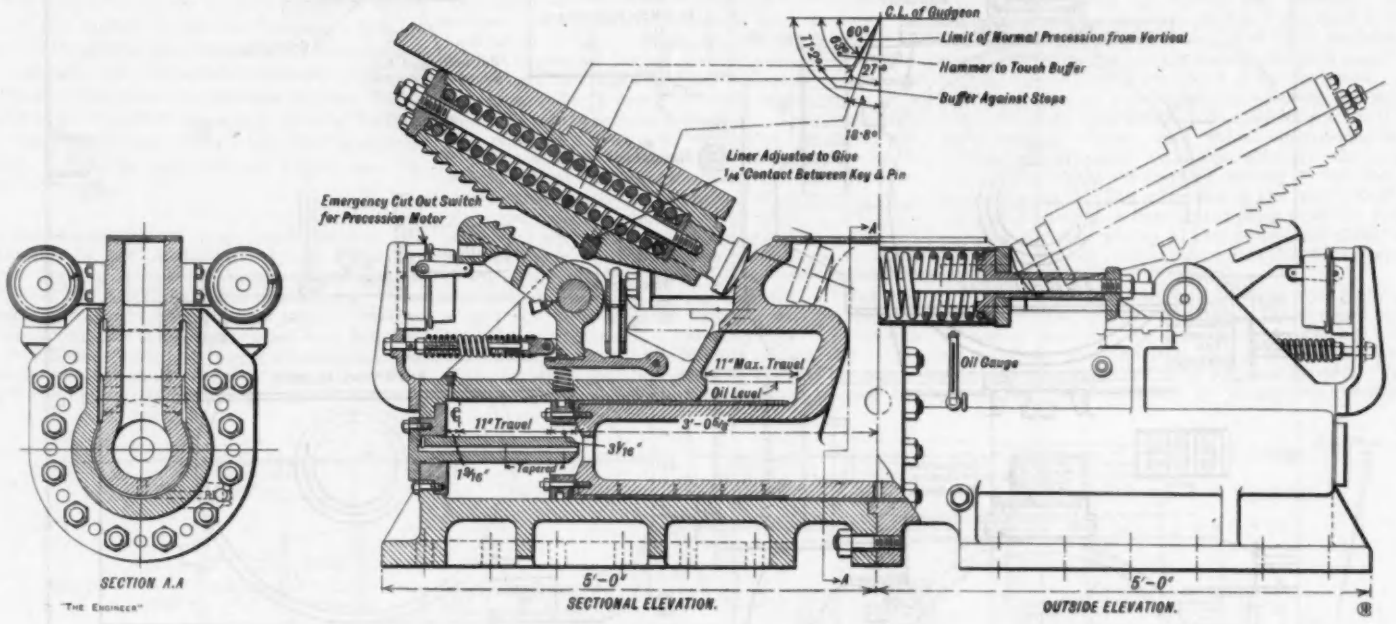
† This speed, although it is about 14 m.p.h. in excess of the world's record seaplane speed, is not as high as the blade tip speed in some modern turbines in which 1000ft. per second may be reached safely.

ARRANGEMENT OF STABILISERS ON THE CONTE DI SAVOIA



"THE ENGINEER"

accompanying engravings. Attached to the cylindrical portion of the casing are two hammers, one forward and one aft of the trunnion axis. The hammer or ram is contained inside a body, which is attached firmly to the gyroscope casing. If the hammer head struck an immovable object, the body and gyroscope casing could move against the compression of a spiral spring through a distance of 2in., as measured by the travel of the body on the shank of the hammer. The actual obstacle placed in the path of the hammer is not, however, immovable, but is an abutment projecting upwards from the middle of a double-ended hydraulic ram. This ram is normally centralised by means of a pair of spiral springs. From the central position it has a maximum travel of 11in. horizontally

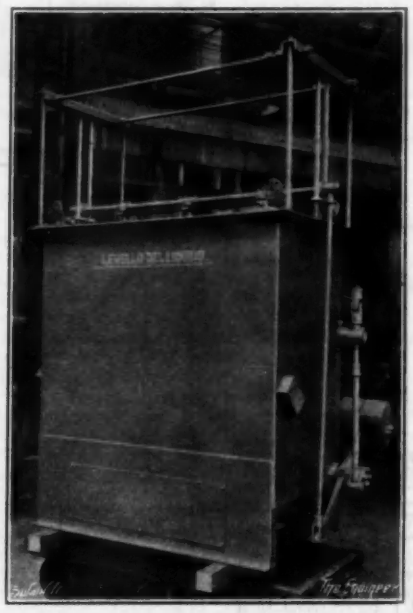


DETAILS OF BUFFER STOP

in either direction. The ram is hollow, and is filled with oil. At each end it is provided with a central orifice. Almost immediately the ram begins to move under the force exerted on it by the spring hammer, the orifice at one of its ends becomes engaged with and partially blocked by a pin projecting from the end cover of the ram cylinder. This pin is slightly tapered, and hence as the travel of the ram proceeds the extent to which the central hole is blocked by the pin increases. As a consequence, the oil, forced past the pin into the interior of the ram, applies an increasing resistance to the movement of the ram. In this manner the energy of the rocking motion possessed by the gyroscope at the instant at which it strikes the stop is absorbed at first resiliently by the hammer spring and finally non-resiliently by the viscous motion of the oil in the buffer cylinder. It may perhaps be made clear that the forward, or left-hand, hammer, as shown in our engraving, co-operates in its action with the pin at the right-hand end of the ram cylinder, and *vice versâ*.

The gyroscope may precess 60 deg. away from the vertical in either direction without bringing the buffer-stop into action. If the precession reaches 63 deg. the hammer head will just touch the abutment on the ram. The extreme limit of the tilt is reached at 71·2 deg. At that tiit the hydraulic buffer has moved through its maximum travel of 11in. and the hammer spring is fully compressed. At some degree of tilt intermediate between the two last-named figures a small projecting key of hardened steel, fixed on the underside of the hammer body, strikes the top of a vertical plunger pin. The descent of this pin releases a trigger which previously has been holding a two-armed lever in the disengaged position. One arm of this lever has a pull applied to it by a tension spring. The other arm is formed with three buttress teeth. On the release of the trigger this arm, moving upwards, engages its teeth with corresponding teeth on the underside of the hammer body, and thereby prevents the return of the gyroscope to the vertical position. The gyroscope will remain locked in this manner until the engineer in charge unlocks and resets the device with the aid of a tommy bar inserted in a bore-hole in the end of the three-toothed arm. That arm in the disengaged position holds down the handle of a cut-out switch forming part of the precession motor circuit. When therefore the arm moves upwards to lock the gyroscope the switch arm is set free to rise and break the precession motor circuit.

Lest there should be some doubt on the subject it may, perhaps, be desirable to state that the energy to be absorbed by the buffer system is simply that corresponding to the velocity with which the whole gyroscopic system—that is, the fly-wheel, the casing and its attachments—is tilting about the precessional axis at the instant of impact. It is not in any way called upon to absorb the energy or any portion of the energy corresponding to the velocity of spin of the fly-wheel on its axle. For the purpose of determining the maximum amount of energy with which the buffer may be called upon to deal it is strictly justifiable to assume that the fly-wheel is not rotating. In other words, the total energy in the system when it is in operation can be regarded as consisting of two separate and distinct quantities, the energy of rotation of the fly-wheel about its axle and the energy corresponding to the precessional velocity with which the fly-wheel, casing, &c., are tilting about the athwartship axis. We have already stated that the polar moment of inertia of the fly-wheel is 4·9 million in pounds and feet. Hence, at 910 r.p.m. the energy in the fly-wheel corresponding to its velocity of spin is 695 million foot-pounds, or sufficient to raise its own weight over half-a-mile vertically. The moment of inertia of the fly-wheel, casing, &c., about the precessional axis is approximately 26·7 million in pounds and feet. The maximum precessional velocity is, as stated in the preceding article, 0·262 radian per second. The maximum energy of precession is therefore about 28,600 foot-pounds, or, say, 37 B.Th.U. It is this second quantity of energy with which the buffer system has to deal and of it, it will be required to absorb the whole amount only in the event of the stop being struck by virtue of the complete failure of the action of all three of the magnetic brakes.



LIQUID RHEOSTAT

The amount of energy in the spinning fly-wheel may appear to the uninstructed general public enormous and even startling. It would be wrong to ignore criticism on this point. Fortunately, it is quite easy to answer it by means of a comparison which the lay mind will readily understand. The amount of energy stored in the fly-wheels is small compared with the amount of energy stored in the ship's boilers. We do not possess details of the boilers of the "Conte di Savoia," but we have available the necessary figures for the "Monarch of Bermuda," a vessel of half the tonnage of the new Italian liner. The "Monarch's" eight Babcock and Wilcox boilers generate steam at 400 lb. pressure and 650 deg. Fah. They contain between them a total of 50 tons of water, 1440 cubic feet of saturated steam and 416 cubic feet of superheated steam. The total heat contents of the boilers therefore amount to about 48·8 million B.Th.U., or, at any instant, each boiler contains about 4750 million foot-pounds of energy. The energy stored in one boiler is therefore nearly seven times as great as the energy stored in one of the "Conte di Savoia's" fly-wheels running at full speed.

It was originally proposed that all the three stabilisers should be governed by means of a single control gyroscope, the intended object being to make perfectly sure that the units, if more than one were in action, would work in exact phase with each other. This intention was ultimately abandoned in favour of fitting a separate control gyroscope for each unit. This modification simplifies the wiring arrangements and reduces the size of the contacts operated by the control gyroscope in establishing and breaking the circuit to the precession motor and brake. No great difficulty is anticipated in securing the synchronous action of the three units, in spite of the fact that each is separately controlled.

The control gyroscope consists of a small fly-wheel rotating at 6000 r.p.m. inside a casing. The spinning axis lies horizontally athwart the ship and the precession axis is vertical. In this connection it should be noted that in the diagram of the Sperry system, reproduced in the previous article, the stabilising unit is shown in vertical athwartship section, while the control gyroscope for the sake of simplicity is shown in plan. Incipient rolling of the ship causes the spinning axis of the control gyroscope to precess in a horizontal plane forward or aft, according to the direction of the incipient roll. A very slight degree of movement brings an electrical contact on the casing against one or other of a pair of fixed contacts. The precession motor is thereupon started up and the stabiliser brought into action with a time lag, which should never exceed about one-fifth of a second. The sensitiveness of the control gyroscope—in other words, the minuteness of the heeling motion which will occur before it brings the stabiliser into action—can be controlled by adjusting the springs whereby the contact member on the control gyroscope casing is centralised between the two fixed contacts. The control gyroscope is, in addition, equipped with an adjustment whereby it is possible to rectify any tendency of the stabiliser to oscillate through unequal arcs fore and aft.

In conjunction with each of the three stabilising units there are a motor generator set—see page 72—for supplying the alternating and direct current to the spinning motor and the precession motor and brakes respectively, a liquid rheostat with a water circulating pump, a switchboard and equipment for circulating, cooling—or heating—and purifying the lubricating oil. The necessity for a rheostat requires a word of explanation. If the fly-wheel running at the top speed of 910 r.p.m. has to be stopped it would, if it were allowed simply to coast to rest, continue by its own momentum to rotate for at least four hours. To reduce this time the spinning motor can be switched over to act as a generator supplying current to the motor of the motor generator set. The output of that set is in these circumstances passed to the rheostat. With this electrical brake in action the wheel can be stopped from 910 r.p.m. in fifty minutes. In the reverse direction the time required to speed up the fly-wheel from rest to 910 r.p.m. is between eighty and ninety minutes, the actual figures being, by test, eighty-two minutes for the first set, eighty-six minutes for the second, and ninety minutes for the third.

During the shop tests at Barrow each set was run continuously for eighteen hours at 910 r.p.m. and was given a final five minutes over-speed test at 1000 r.p.m. The precession gearing was not tested with the wheel spinning. Some doubt was felt as to the ability of the shop foundations to withstand the reaction which would have been developed upon them.

Included among our engravings will be found reproductions of drawings showing the disposition of the stabilising equipment as it will be installed on the "Conte di Savoia." These drawings will, we believe, be studied by naval architects with considerable interest, more especially from the point of view of the frequently expressed criticism of automatic stabilisers to the effect that their use throws a high local load on the ship's structure. From that point of view it might perhaps have been expected that the three units for the Italian liner would have been distributed along her length. Far from that course being followed, those responsible for the equipment have had no hesitation in concentrating the whole of it in a compartment just forward of the bridge and at or below the water level. The total weight of the equipment is a little over 600 tons, or about 1·35 per cent. of the ship's nominal displacement. In addition to this weight there is developed when the equipment is in full action a downward force of about 109 tons on each of three bearings and an equal upward force on each of three other bearings.

Each precession journal bearing, it will be noticed, is supported on a pedestal extending 12ft. longitudinally, or over five or six of the ship's frames. Stabiliser No. 1 is situated on the ship's centre line, and each of its pedestals is supported on stays from the ship's side and tank top. Stabilisers Nos. 2 and 3 are arranged athwartship about 30ft. aft of No. 1. The outer pedestals of these two stabilisers are stayed to the ship's sides and tank top while the inner pedestals are supported from the tank top. The load on the pedestals consists of the weight of the flywheel and casing and the gyroscopic reaction. The remaining portions of the stabiliser consisting of the precession motor, the brakes, the precession reduction gearing and the buffer stops are carried directly on the tank top. We understand that it has not been considered necessary to strengthen the general structure of the ship to meet the stresses thrown upon it by the stabilising equipment, except in so far that the midship section scantlings have been extended to a point further forward than would be usual in a non-stabilised vessel of the same size.

Harbours and Waterways in 1931.

No. II. (*conclusion*).*

Scotland.

ON July 10th H.M. the King opened the new Shieldhall Basin at Glasgow and gave it the name of King George V. Dock. This work is the first part of a large scheme of open basins and quays prepared many years ago by the Clyde Trust, but it was not until 1924 that work on it was begun. The whole scheme involves the expenditure of about £10,000,000, and for the purpose 643 acres of land between Shieldhall and Renfrew on the south side of the river have been acquired. The first basin, which the King inaugurated, is 2483ft. long and 350ft. wide with a water area of 20 acres. The entrance is set back from the river bank to give a clear width of 650ft. in the channel. The additional quayage provided in the basin has a total length of 6450ft. and the berths have a depth of water of 32ft. at M.L.W.S.T. The construction of the basin has entailed the diversion of the adjacent main roads for a length of about 2 miles. The cost of the work so far carried out, including the equipment of the quays with sheds and cranes, has amounted to about £2,000,000.

A contract was placed by Barclay, Curle and Co., Ltd., with Sir Robert MacAlpine and Sons for the construction of a new dry dock at Elderslie, Scotstoun. The new dock will have a length of 620ft. and an entrance width of 85ft. The depth over the sill at M.H.W.S.T. will be 28ft. Adjoining the graving dock a fitting-out wharf is being constructed and the total cost of the works is likely to be about £500,000. The existing Elderslie dry dock, near which the new dock is being built, is the largest privately owned dry dock on the Clyde, but is only 525ft. in length and has an entrance width of 67ft. Another dry dock on the Clyde, that owned by the Greenock Harbour Trustees at Garvel, is being enlarged by the reconstruction of the entrance, the effective width of which will be increased from about 50ft. to 69ft.

The Leith Dock Commissioners have placed contracts for a grain elevator and store-house to take the place of the structure which was destroyed by fire early in 1930. The new installation will be larger than the old one and the granary will have a capacity of 25,000 tons of grain. The Commissioners have also provided during the year two new movable hydraulic coal hoists. The wagon traversers which serve these hoists embody a new development in relation to such appliances, electric-hydraulic transmission being employed for the traverser gear.

* No. I. appeared January 8th.

The London, Midland and Scottish Railway Company has embarked upon a large programme of improvements at its coal ports, including the provision of eight electric conveyor belt installations for shipping coal at Glasgow, Ayr, Troon, and Grangemouth, in addition to one at the company's terminal at Swansea. One only of these is at present in use, namely, that at the general terminus, Glasgow, but four others are in course of construction. Provision has been made in the case of all these plants for side-tipping coal wagons by means of an oscillating tippler which turns the wagon upside down. No turn-tables are required, as the wagons will run through the tipping platform on gravity roads. The London, Midland and Scottish Railway Company is building an oil jetty in the eastern channel at Grangemouth which, when completed, will enable ships carrying oil to be separated from those loaded with general cargo which make use of Grange Dock.

Ireland.

Considerable progress has been made with the construction of the new turning basin, quays and approach channel on the County Antrim side of Belfast Harbour. These works were begun by the Belfast Harbour Commissioners in 1930. At Dublin the deep-water quay in the Alexandria Basin, the underwater portions of which consist of reinforced concrete caissons of exceptionally large dimensions, was brought into use during the year. The new quay adds 1400ft. of berthage to the harbour with a depth of 32ft. at M.L.W.S.T.

Other Ports in the United Kingdom.

The construction of a new and larger lock to give entrance to the wet dock at Shoreham, begun over a year ago, is still in progress. The import of coal cargoes for the Brighton electric supply station, which is situated on the south side of the Shoreham Dock, has rapidly increased in recent years, and the new lock will, when it is in operation, enable much larger coal-carrying vessels to reach the quays of the power station.

The London and North-Eastern Railway Company began an extension of Parkeston Quay at Harwich, and in October placed contracts with the Yorkshire Hennebique Company for the widening of the existing quay and the construction of an extension, 1120ft. long by 150ft. wide, with two approach viaducts, all of which will be in reinforced concrete. A contract was also placed for the dredging work in connection with the extensions and the reclamation of a marshy area adjacent to the works. It is expected that the building of the new quay will occupy about two years. The work will involve the driving of about 1500 reinforced concrete piles.

In November the new frain ferry service of the Great Eastern Train Ferries, Ltd., between Harwich and Calais, was brought into use. It will be remembered that the Harwich train ferries, although owned by a separate company, are operated by the London and North-Eastern Railway Company.

The London, Midland and Scottish Railway Company obtained in the 1931 session of Parliament powers for the construction at Fleetwood of a new dock and lock entrance and other works at that port to which we made reference a year ago. The scheme is estimated to cost about £750,000, and provides for much-needed additional accommodation for the fishing fleet using the port. A new wet dock will be formed by enclosing a portion of the open quays and building dock walls out into the River Wyre.

The Southern Railway Company has undertaken to carry out a harbour improvement scheme at Padstow on the north coast of Cornwall, intended primarily for the benefit of the fishing industry of the port. The works are being assisted by grants from the Development Fund and the Unemployment Grants Committee, and it is expected that the work will be begun early this year. Harbour improvements were completed at several fishing ports during the year, including the construction of a small breakwater at Port Isaac and the extension of the west breakwater at Staithes on the Yorkshire coast. Harbour improvements at Seahouses, a small fishing port on the Northumberland coast, are to be begun early in the present year, the work being assisted by a grant from the Development Fund.

Inland Waterways of the United Kingdom.

The Grand Union Canal Company obtained the powers sought in Parliament last year to carry out the works embraced in its £1,000,000 development scheme. It will be remembered that following on the successful amalgamation of a number of minor concerns which became the Grand Union Canal Company, the improvement of the several navigations was energetically proceeded with. The policy of the company has been so successful as to call for commendation by the Royal Commission on Transport, whose report we have already briefly referred to. The company has now arranged to purchase certain other canal undertakings, including the Leicester Navigation, the Loughborough Navigation, and the Erewash Canal, for which purpose additional parliamentary powers were obtained in the course of the year. The canals to be thus acquired have a total length of 37 miles, and they link up the London–Birmingham and Leicester–Birmingham systems with the Trent Navigation. A scheme has already been prepared for the substitution of fewer and larger locks for the seventeen narrow locks near Daventry and Foxton, at an estimated cost of £150,000. The company has also entered into an agreement with the Oxford Canal Navigation, by which it obtains virtual control of a short but essential link in the main line of its canal system. The Canal Company has undertaken an extensive programme of dredging and has brought into service several new bucket dredgers worked by crude oil engines which have been specially designed for canal service. An expenditure of £282,000 is proposed to be made during the next few years on concrete side walling to protect the canal banks from the wash of boats and incidentally to increase the width of the waterway in narrow reaches.

EUROPEAN PORTS AND WATERWAYS.

The progress of public works in France is being adversely affected by the world depression as in our own and other countries. The deep-water quays and the new maritime railway station at Cherbourg, begun in 1928, have made some progress towards completion, but much remains to be done before Transatlantic liners, for which they are intended, can make use of them. At Marseilles, also, progress with the port work extensions has been restricted. Competition of Le Havre with Rouen is probably responsible for some of the activity in connection with new works at the former port. New quays suitable for berthing the largest Transatlantic liners are under construction at Havre. Reinforced concrete caissons sunk under compressed air and somewhat similar to those for the new quays at Cherbourg are being used in the substructure of the walls. The development of the oil basin and tank storage and the extension of the storage accommodation on the south side of the new outer harbour is being continued by reclaiming the foreshore. At La Pallice, near La Rochelle, the building of a new deep-water pier has been begun as the first item in a programme that aims at the creation of a new port of call for Transatlantic liners. The approach viaduct which will give access to the pier is now being built, the works having been begun in August. The deep-water pier, alongside which it is intended that Transatlantic liners shall berth, will carry a railway station and other terminal facilities. It is expected that it will require about seven years to complete the work. The works at Le Verdon, on the southern side of the Gironde entrance, begun nearly two years ago, which also have as their object the provision of a deep-water port for Transatlantic traffic, are still in progress. At Rouen some extensions in the form of new quays and wharves and the provision of new equipment, particularly for the storage of oil, were carried out during the year.

The development of the northern inland waterways system of France continued, particularly in the direction of equipment of the canals for electric traction, either by trolleys or tractors. It is reported that the work of deepening and widening the Rhine-Rhone Canal is practically completed, and it is now possible to navigate 280-ton barges between the two rivers. No progress, however, appears to be made with the project for the provision of an inland waterway which will connect the Rhine-Rhone Canal with the Marseilles-Rhone waterway at Arles. The canalisation of the Rhone itself as originally proposed is probably impracticable, and the only alternative is the construction of the lateral canal which is desired by Marseilles trading interests.

In September two large dry docks were brought into use at Antwerp. They were constructed for the Antwerp Engineering Company of Hoboken. The larger is 710ft. in length and 85ft. in width, and the smaller 590ft. by 63ft. In the construction of both of them reinforced concrete was largely employed.

In view of the present financial situation of the country and the general uncertainty with regard to the development of Dutch agriculture in the near future, the Netherlands Government considered it desirable to suspend work on the reclamation of the south-east and south-west polders of the Zuider Zee scheme. The first of the four polders, that known as the north-western, was dried out over a year ago, the work being completed in September, 1930. On other parts of the scheme work is still in progress, and it is expected that the main dam, which will close the Zuider Zee to the sea, will be completed about the end of the present year. It is now stated that the cost of the main dam, with its locks and other works, is likely to be £14,000,000, while that of the north-western polder will be about £8,300,000, and it is realised that these costs are higher than the probable value of the reclaimed land. Further investigation is proceeding into the scheme for the reclamation of the north-east polder.

To some extent the progress of port works in Italy was slowed down during the year, but at Genoa work is still proceeding on the westward extension of the Principe Umberto mole. The section now being built in a depth of water of from 15 m. to 20 m. is a vertical wall of superposed concrete blocks, each weighing about 350 tons, founded on a rubble mound at a depth of 11½ m. below water level. For the purpose of setting these huge blocks a second floating crane of a lifting capacity of about 550 tons

was recently brought into service. The lengthening of the large Grazie dry dock on the east side of the harbour of Genoa, which was necessitated by the building of the new Italian Transatlantic liners, was completed in June. The original dock, built since the war, was first brought into use in July, 1928. It has now been lengthened by 65ft., making its total internal length 828ft. The width of entrance is 106ft. The new quays at the Ponte A. Doria, for the accommodation of the largest Transatlantic liners using the port of Genoa, are being built of reinforced concrete caissons sunk on a rubble-stone foundation at a depth of 36ft., and afterwards filled with weak concrete and sand. The quays will, it is expected, be brought into use during the spring of 1932. The older parts of the Doria Quays consist of walls founded on foundation caissons sunk under compressed air.

The building of the island breakwater, about 350 m. in length, which protects the western entrance to the harbour of Naples from southerly and south-westerly winds, was completed up to water level during the year. This structure, which consists of a vertical wall founded on a rubble mound in a depth of water ranging from 80ft. to 137ft., is about 1140ft. long. The superstructure up to water level is formed by three superposed tiers of cyclopean concrete blocks, each weighing over 400 tons and placed in position by a floating crane The wall will be surmounted by a mass concrete capping and parapet, which are now being built. The cost of the work has been upwards of a half a million pounds.

The building of quays and jetties on the eastern or Graneli side of the harbour, under the shelter of the Graneli mole, has been in progress since the year 1924. These works are now practically completed, the projecting jetties being on the average 250 m. in length and 103 m. wide. They are built of concrete blocks, weighing from 55 to 82 tons. A total additional length of about 8750ft. of new quayage is provided by the construction of the walls and jetties, all of which have a depth of water in the berths alongside of at least 34ft.

The greater part of the first section of the breakwater at Bari, begun in 1925, 1850 m. in length, has now been completed up to water level, but the mass concrete superstructure remains to be added. Its total length will be 2300 m. and it is being built, like the new breakwater at Naples, of cyclopean blocks of 360 tons weight, founded on a rubble mound at a level of 34ft. below water level. For a large part of its length the breakwater is in over 50ft. of water. The contract for the construction of the Bari harbour works, which involves an expenditure of nearly £2,000,000, is not expected to be completed before 1937. In addition to the breakwater it includes numerous subsidiary works, among them the building of several quays and jetties in the harbour.

Port extension works have also been under construction at Leghorn since 1924 and are expected to be completed and brought into use towards the end of this year. They have involved an expenditure of over 85 million lire and include a new access channel 30ft. deep, leading to the inner harbour, and the construction of about 3100 m. of new quays and an oil import basin.

A large dry dock at Cadiz, begun in 1930, is expected to be ready for use this year. It is 235 m. long, 38 m. wide internally and will have a depth of water over the blocks at high water of ordinary spring tides of 10·5 m. The bottom of the dock is formed of reinforced concrete caissons floated over and sunk in position on a site dredged to the required depth.

The new Polish port of Gdynia continues to grow, and its equipment as a coal exporting port is planned on an elaborate scale. The shipments of coal already rival those at the neighbouring port of Danzig, and in 1931 reached approximately 5 million tons. Seven years ago the site of the port was nothing more than a fishing village.

The two breakwaters which have been under construction at Candia on the north side of the island of Crete since 1923 were completed at the end of 1930. They enclose a water area of approximately 400,000 square metres, having an average depth of water of 10 m. The western breakwater is 1000 m. long and the eastern 750 m. It was originally intended to construct the breakwaters as rubble mounds capped with a mass concrete superstructure, but soon after the works began it was found that this design was inadequate to resist the wave action. The design was thereupon modified and the breakwaters have been built of concrete blocks set in sloping bond on a rubble mound foundation for the most part at a depth of 10 m. or more below water level. The contract for the construction of the breakwaters was carried out by Sir Robert MacAlpine and Sons and the cost is stated to have been about £370,000.

Another British firm, Sir Lindsay Parkinson and Co., Ltd., has secured the contract for harbour extensions at Famagusta, Cyprus, which include the building of quay walls and other works at a cost of £200,000, and are expected to be completed in 1933.

AFRICA.

The Port Elizabeth harbour scheme has undergone some modification. Early in the year a revised plan prepared in view of the present financial stringency was adopted by the South African Railways and Harbour Board. The original scheme contemplated a curved breakwater about 8000ft. in length thrown out from the Dom Pedro Jetty. It is now to be 5100ft. in length. The Dom Pedro Jetty is to be converted into a solid work as originally intended, but the North Arm on the opposite side of the harbour will be constructed in the form of a rubble mound about 2600ft. in length, a portion of which will be provided with a quay face to be used by mail steamers. From the inner face of the breakwater it is proposed to throw out another arm, also of rubble work, called the East Arm. This will be about 2800ft. in length and with the North Arm will enclose an inner harbour of about 263 acres, a portion of which is to be dredged to a depth of about 35ft. below low water.

At Table Bay the new harbour works have progressed so far as to permit of the first berth in the new Southern Basin being brought into use. The new berth has a length of 650ft. with a depth of 25ft. at low water. Work is proceeding on the second and third berths ; the latter, when completed, will have a depth of 36ft., which may be increased to 40ft. by dredging. The rubble mole on the south side of the new basin is completed with the exception of the head works. The extension of the outer breakwater has been proceeded with, but is still far from reaching its intended length of 1500ft. A 60-ton floating crane is now being built for Table Bay Harbour and is expected to be delivered in June. Fourteen other cranes are being built for the new quays in the harbour.

The deepening of the entrance channel at East London to 35ft. at low water has been continued during the year, and a new quay, 1000ft. in length, is being built. In connection with the channel improvement works a turning basin 1000ft. wide is being dredged.

For Durban Harbour fifteen cranes are now being constructed, one of which is an 80-ton fixed crane and another a 25-ton floating crane. A new dredger arrived at Durban during the year to replace the old dredger "Nautilus." The vessel is a twin-screw suction dredger with a hopper capacity of 5000 tons and is capable of dredging to a depth of 70ft. below water, and can load the hopper with sand in sixty minutes. Quay extensions are in progress on the Congella side of the harbour and the extension of the south breakwater for 300ft. seaward, begun in 1929, is not yet completed.

We referred a year ago to the completion of the wharf at Lobito Bay in Portuguese West Africa. In March the extension of the Benguela Railway from the frontier of Angola was linked up with the railways of Central and Eastern Africa. The completion of this line provides through railway communication across Africa from Lobito Bay on the Atlantic to Beira on the Indian Ocean. At the latter port the construction of deep-water wharves and the deepening of the harbour are being continued.

It is now announced that the present programme of works—authorised in 1921—for the improvement of the Suez Canal will be completed by the end of 1934. The limiting draught of vessels using the canal will then be 35ft.; curves are being flattened to a minimum of 3000 m. radius, and on all straight reaches the minimum bottom width will be 60 m. The present limiting draught of vessels is 33ft.

At Algiers a coaling wharf is being constructed on the inner face of the eastern jetty or mole which forms the outer protection of the old port. Work has been continued on the building of the Mustapha breakwater begun in 1927, in which cyclopean concrete blocks of over 400 tons weight are used.

The French port of Casablanca in Morocco continues to develop rapidly. The seaward extension of the great breakwater has been proceeded with ; the internal transverse mole has been completed and additions have been made to the wharf accommodation.

THE EAST.

The Imperial Shipping Committee issued in September a report of an inquiry made into the scheme for the provision of additional deep-water berths at Port Swettenham, in the Federated Malay States. The complete scheme involves an estimated expenditure of £4,200,000, but the Committee recommends the immediate construction of the first part of the works, estimated to cost £1,300,000. The works comprised in this section include the construction of 1000ft. of wharfage having a depth in the berths alongside of 33ft. at low water.

The two breakwaters at Haifa in Palestine begun in 1929 are nearing completion. Both are rubble-mound structures ; the main or north arm is 1¼ miles long and the lea or west breakwater about ½ mile long.

The work of dredging the deep channel through the Fairy Flats in the approaches to the Whangpoo River from the Yangtse is shortly to be commenced. The Whangpoo Conservancy Board has already placed an order for dredging plant, and it is expected that operations will be begun on the site in 1932.

Work was started on the new outer breakwater at Yokohama, which is to be 2273 m. long and will take ten years to build. When completed the sheltered area in the harbour will be almost doubled. The new work is being built in a depth of water averaging 12 m. at low water. The design comprises a submerged rubble mound with a superstructure of floated reinforced concrete caissons founded on the mound at a depth of 21ft. and afterwards filled with stone rubble.

The harbour improvements at Cochin, on the south-west coast of India, to which we have repeatedly referred in our annual surveys, are now reported as complete so far as the original plan for the improvement of the harbour entrance is concerned. This bold experiment in dredging through a bar without having recourse to jetties or training banks seems to have been completely successful, and there is now a depth of 37ft. throughout the channel, which is about 2 miles long and 450ft. wide. The new dry dock is finished and work has been started on the reclamation of land in the lagoon area. Plans for the further development of the inner harbour at a cost of over £1,000,000 sterling are under consideration.

The Strand Market Wharf at Rangoon was opened by the Governor of Burma in February. The completion of this work adds 1700ft. to the deep-water wharf accommodation in the port.

The large floating dock which Swan, Hunter and Wigham Richardson, Ltd., have constructed for the Harbour Board of Wellington, New Zealand, left the Tyne in tow for its destination on July 15th, and arrived at Wellington on December 28th. The route taken was *vid* the Suez Canal. The dock has a lifting capacity of 17,000 tons and is 584ft. long overall. The clear width between the fenders is 88ft. and it has a maximum depth of water over the keel blocks of 26ft.

The Sydney Harbour Commissioners are extending the wheat loading terminal at Glebe Island by constructing large storage sheds and new wharves on the east side of the site. The additional storage amounts to about 60,000 tons, bringing the total storage capacity of the terminal for bulk and bagged wheat up to 271,000 tons, or over 10 millions of bushels.

NORTH AND SOUTH AMERICA.

After negotiations extending over several years, the authorities of New York City and the State of New Jersey have secured from the War Department permission to encroach to some extent on the deep-water channel beyond the conservancy lines of the Hudson River for the construction of new piers between West 23rd-street and West 121st-street on the New York side and on a similar frontage on the opposite or New Jersey side of the river. This concession will enable a number of piers, 1000ft. in length, to be built for Transatlantic liners, and, in fact, some of them will have a berth length of as much as 1200ft. by recessing the bulkhead line towards the shore. The effect of this agreement is to advance the pierhead lines by about 75ft.

The United States War Department has now definitely decided that future bridges over the Hudson River in the New York area must have a clear headway of 200ft. above mean low water. This is the clearance which has been provided in the case of the George Washington suspension bridge between New York and New Jersey, which was opened on October 24th.

The Federal Government is proceeding with the opening up of Jamaica Bay, the large, sheltered water area which lies to the east of Brooklyn and Coney Island, by forming a 30ft. deep channel up to the head of Cornell's Creek. Already three millions of dollars have been expended in dredging, out of an estimated cost of 10 millions. In connection with this project the building of a protection jetty or groyne, 8400ft. long, from Rockaway Point, has been begun, and is expected to be completed towards the end of 1933, when the deepening of the entrance channel, which the jetty will shelter, will be proceeded with.

The absence of a regulating lock on the Cape Cod ship canal, connecting Cape Cod Bay on the east side with Buzzards Bay in the west of the Cape Cod isthmus, has been, since the waterway was first opened to traffic in 1914, a cause of difficulty on account of the difference in sea levels at the two ends. There is at times a considerable current flowing through the canal, and the American Secretary of War has submitted to Congress a report by the Chief-of-Engineers recommending the construction of a regulating lock, 1000ft. long and 110ft. wide internally, with 40ft. depth. Since the canal was first opened to traffic, its depth has been increased to 25ft., and it is now proposed to carry out further improvements, which will provide a depth of 30ft. throughout the waterway.

The United States Government has made an appropriation of £5,500,000 for the deepening of the Great Lakes channels between Duluth on Lake Superior and Detroit, which is situated on the Detroit River between Lakes Huron and Erie. The scheme provides for a depth of 26ft. and the programme will require about eight years for its execution. The total cost of the scheme is estimated at £15,000,000.

The new State Board of Harbour Commissioners at San Francisco has commenced a large programme of water front improvements, including the construction of a number of deep-water piers, most of which will be 800ft. in length.

The Mississippi River flood control scheme, prepared by the Commission under the chairmanship of the late Lieut.-General Jadwin in 1927, once again came before Congress in December. The scheme, estimated to cost approximately 325 millions of dollars, made no provision for compensation for floodway land damages which would inevitably ensue from the use of the vast emergency spillways proposed

by the plan. Congress adopted the scheme in 1928, but since then landowners in the river valley have strenuously opposed it on the ground of lack of provision for compensation, and their contentions have been upheld by the courts. The outcome is that the whole of the proposals, financial and engineering, are to be reconsidered. Estimates of the total indebtedness if the works as proposed are carried into effect, and provisions made for land damage are vague and vary widely. There seems to be no doubt that the total would be at least twice the original estimate.

The first section of the extension of the harbour works at Quebec, begun in 1925 at Wolf's Cove, was brought into use during the year, and the first Transatlantic liner to berth alongside the new wharf was the Canadian Pacific Railway Company's 47,000-ton ship "Empress of Britain." The ship berths have a low water depth of 40ft. The first section of the Wolf Cove terminal includes about 4300ft. of quay wall, with a large area of reclaimed land behind it. Work on a further extension of the walls and quays is now being carried on. The new tunnel, which provides direct access for railway traffic to the Cove, was also brought into use during the year.

The new port of Churchill on the Hudson Bay was opened last year by the loading of the first commercial cargo of wheat at the port in the s.s. "Farnworth" in September. The construction of the port was actively begun in 1927; 1800ft. of quay wall have been built and a grain elevator of 2½ million bushels capacity erected. The plans for grain storage provide for an ultimate capacity of 10 million bushels. It is hoped that the port will be open for navigation for about three months in each year.

A large part of the port works at St. John, New Brunswick, were destroyed by fire in June, but reconstruction work on the Canadian Pacific Railway terminal was begun almost immediately after the disaster. The Dominion Government promptly lent 10 million dollars to the Harbour Commission for the rebuilding of the port works. The first works to be undertaken are a pier for ocean liners, a large grain elevator to hold 1½ million bushels of wheat, which is now nearing completion, and transit sheds. It was announced that some part at any rate of the reconstructed works would be ready for the accommodation of ocean shipping by the end of 1931.

The new Welland Ship Canal connecting lake Erie and Ontario, although not fully completed, is already in use, though the draught of vessels using it is at present limited to 18ft. When the constructional works are fully completed the minimum depth in the waterway will be 25ft., which it is intended ultimately to increase to 30ft.

The St. Lawrence waterway project continues to receive a good deal of attention, both in Canada and in the United States. In October the Canadian Prime Minister, Mr. Bennett, announced that negotiations would begin at once between the Governments of Canada and the United States with the object of framing a treaty for the development of the waterway. The investigations and negotiations will not be conducted by a joint commission, but will be carried on through diplomatic channels. The existing waterway between the lakes and Montreal is limited to small vessels of a maximum draught of 14ft. On the other hand, the completion of the Welland Ship Canal, which is about to be realised, opens up the whole of the Great Lakes to vessels of about 23ft. draught, and the available draught can, at a comparatively moderate expenditure, be still further increased. The St. Lawrence project receives general support throughout Canada except in the Province of Quebec, where it is feared that the enlarged waterway will have the effect of restricting the development of the trade of Montreal.

In the meantime, the construction of the first section of the Beauharnois Power Canal undertakings has been about three-quarters completed. The power-house was finished in October and a considerable part of the mechanical equipment has been installed. The construction of the canal between Lake St. Francis and Lake St. Louis, near Montreal, will, in addition to providing hydro-electric power to the extent of 500,000 H.P. in the first stage of development, constitute a navigable waterway which will be, in the future, one of the links of the continuous deep-water navigation between the Great Lakes and Montreal. The canal now being built has a length of about 16 miles from Lake St. Francis to Lake St. Louis. The locks will be at the lower, or St. Louis end, the water level of the canal throughout being that of Lake St. Francis. The ship channel will have a minimum width of 600ft. and a depth of 27ft. We published an illustrated description of the canal in our issues of February 13th and 20th, 1931.

The Montreal Harbour Commissioners are constructing new wharves at Windmill Point; one side of the King Edward Pier is being rebuilt and other harbour improvements are in progress. It was estimated that an expenditure of approximately £700,000 would be incurred in wharf construction and improvements in the port during the working season of 1931.

The investigation of water supplies for the Panama Canal has been continued. It will be remembered that the favoured scheme, known as the Madden Dam project, contemplates the construction of a dam and reservoir at Alhajuela, on the Chargres River. Already £200,000 has been expended in the construction of a road to the dam site, and on other preliminary works, and in the autumn tenders were invited for the construction of the dam and reservoir works. A description of the Madden Dam scheme will be found in our issue of August 21st last.

It will be recalled that another United States Government Commission has been for some time studying a project to construct a second inter-oceanic canal in Nicaragua. It was reported that the investigations of the technical commission already indicated that a Nicaraguan canal would cost not less than £140,000,000—nearly twice the amount expended by the United States on the Panama Canal. The Nicaraguan Canal would be 177 miles long, as compared with 50 miles in the Panama. It seems unlikely that such an undertaking as the Nicaraguan Canal will be embarked upon in face of the much less expensive alternative of increasing the capacity of the Panama Canal by the construction of a new series of locks.

The principal wharf at the Columbian Harbour of Cartagena, which was destroyed by fire in August, 1930, is being reconstructed and other works in the port are being carried out at a cost of half a million pounds.

A large grain storage and shipping plant, constructed by Henry Simon, Ltd., of Manchester, at Bahia Blanca, in the Argentine, was brought into use towards the end of the year. It is the largest grain plant in that country and has a storage capacity of 80,000 tons, or about three million bushels.

Water Supply in 1931.

No. II. (*conclusion*).*

Manchester.

DURING the year Mr. L. Holme Lewis retired from the position of Chief Engineer to the Manchester Waterworks Department. He had entered the service in 1895, and was given charge of the whole engineering work of the Department ten years later. He was engineer for the construction of the fourth pipe line from Lake Thirlmere, and for the completion of the Heaton Park 550-million-gallon reservoir. He was made engineer in charge of the design and construction of the Haweswater scheme in 1925. We understand that arrangements have been made by which he, notwithstanding his retirement, will continue to be responsible until its completion for the construction of the first section of the latter undertaking.

In view of the present financial outlook and owing to reduced trade demands, which have lessened the calls on the Water Department, work on the Haweswater scheme has been suspended, except in the case of the contract for the north end of the aqueduct, which The François Cementation Company is carrying out. That undertaking comprises the piercing of the Mardale tunnel—4¾ miles long—and some lengths of "cut-and-cover," tunnel and pipes. Good progress was made on the southern part of the Mardale tunnel, the face being now nearly a mile from the portal. The works road from Shap to the north end of the lake and the road along the south-east side of the lake—lengths of 5¾ miles and 4⅞ miles respectively—were completed.

Newport.

Parliamentary powers were secured for the construction of a reservoir on a site some 1200 yards lower down the Caerfanell Valley than had been originally proposed. A contract was entered into with L. J. Speight, Ltd., for the construction of the first portion of the work, viz., the road diversion, with bridges, stream crossings, &c., and the first portion of the navvy village. These works are well in hand, and at the moment approximately 100 men are employed thereon. It is hoped that the order for the construction of the dam will be given in the forthcoming spring.

Oxford.

The new Shotover covered service reservoir, which has a capacity of three-quarters of a million gallons, was completed, together with a 15in. cast iron main delivering water from the recently completed Headington reservoir to the existing mains through Magdalen College grounds, and a 9in. cast iron rising main connecting the Shotover reservoir with the pumping station at Headington. The construction of the Beacon Hill covered service reservoir near Swinford was continued, and it is expected that it will be ready for testing in the coming spring. Tenders are now being invited for the construction of the intake works, pumping station, sedimentation tanks, filters, and the rising main by which the filtered water will be delivered into the Beacon Hill reservoir. The engineers for these works, all of which are being carried out by contract, are Sir Alex. Binnie, Son and Deacon, the Resident Engineer being Mr. R. Eustace Tickell.

Preston.

On July 9th, a new reservoir, designated Alston No. 1, was opened by the Mayor of Preston. This reservoir, which, when full, has a capacity of 259 million gallons, had been under construction for a number of years. It is formed by an earth embankment four-fifths of a mile long, with a maximum height above ground level of 43ft. and a bottom width of 246ft., the top having a uniform width throughout of 11ft. 6in. The inner, or water, side of the embankment has a uniform slope from top to bottom of 1 in 3 and it is closely covered with large squared stone pitching, laid without mortar and resting upon a layer of small broken stone. The pitching is strengthened by two horizontal concrete sills, one at the foot of the slope and the other two-thirds of the way up. The top edge is finished with a heavy stone coping, both sills and coping being continuous all round the reservoir. The outer slope of the embankment is rather steeper than that of the inner face. In addition to the reservoir, the laying of about 6 miles of new 30in. steel pipe was completed, and it is expected that the first section will be ready for service during the present year. The work includes a double-span steel lattice girder bridge, 132ft. in length, over the river Hodder and a pipe tunnel, 600 yards in length, which is now being driven through limestone formation near Whitwell.

Reading.

A beginning was made at the end of December, 1930, on the construction of a new service reservoir, which will have a capacity of a little over 20 million gallons, and of a water tower having a capacity of 200,000 gallons, with a top water level of 115ft. above ground level. The whole of the work is being carried out in reinforced concrete, which has been designed by Messrs. John Taylor and Sons, of Westminster, in conjunction with Messrs. L. G. Mouchel and Partners, and good progress had been made by the end of last year. Holloway Brothers, Ltd., are the contractors, and the works are subject to an Unemployment Grant, and have to be completed by the end of next year. The floor of the tank of the tower is at present under construction, and the reservoir, which is divided into five separate units, is progressing satisfactorily. The average depth of water in the reservoirs will be 20ft., and the total cost of the work is estimated at approximately £108,000.

Wakefield.

The second instalment of the Ryburn Valley Scheme for the Wakefield Corporation, which was authorised by an Act obtained in 1924, and which will, when finally completed, have cost some £950,000, includes the construction, by direct labour, of the Ryburn Dam, which, itself, is estimated to cost £230,000. The dam is of gravity section and is curved to a radius of 700ft. It is stepped on the downstream side, is 121ft. in height from foundation level, and will impound 220,000,000 gallons to a maximum depth of 100ft. The structure is entirely of concrete, the hearting being of local gritstone concrete, with which is placed, at the same time, a 6in. layer of high-grade concrete of Shap granite to form a harder as well as more impervious facing than is possible with the local material. This granite concrete facing will be dressed with pneumatic tools to give the appearance of axed granite. Rapid progress was made during the year, and the structure, which was begun in 1927, is now substantially completed. The concrete wall was brought up to road level, leaving only the road bridges and four of the overflows to be topped up. The valve tower draw-off pipes and valves were fixed, as was also the spiral stairway giving access to the valves at different levels in the valve tower.

Filtration for approximately one-third of the total compensation water to be delivered from the reservoir is being provided. Two filter units, in reinforced concrete, of the Pennell-Wylie upward filtration type, have been built, and are being housed in a building constructed of pre-cast granite blocks dressed to harmonise with the finished appearance of the facing of the dam. In this house is being installed a small hydro-electric plant by Gilbert Gilkes and Gordon, Ltd., of Kendal, which will provide for all the necessary lighting required at the filter-house and dam, and will also furnish power for pumping up to 400,000 gallons per day, if required, from the reservoir into the Ryburn main.

Further cementation was carried out beyond the North wing trench. Over 1000 tons of cement were injected into twenty-one holes having a total length of about 4000ft. These holes extend in a line approximately tangential to the dam. Apart from a few rotary core-holes for geological purposes, the holes were drilled by percussive hammers, 1⅞in. diameter, in stages of 10ft. They were tested under a water pressure equal to twice the static head of the top water level of the reservoir, and, if leakage occurred, further injection was carried out until the required pressure was reached. Before the cement was set hard, the holes were cleaned out, and drilling continued a further 10ft., and so on. By this method it is claimed that much waste of cement has been obviated, and the grouting has been concentrated at the places where the water tests indicated a possible source of leakage. It is expected that the preliminary filling and testing of the dam will begin in the coming spring.

France.

The chief event of the year was the Government decree declaring that the scheme to bring to Paris

* No. I. appeared January 8th.

a million cubic metres of water a day from the Vals de Loire was a "work of public utility," which means that the Paris Municipality is now empowered to acquire all rights of way that are necessary to carry out the undertaking. Opposition to the scheme, nevertheless, continued on the ground that the withdrawal of such a large volume of water from beneath the sandy bed of the Loire valley would deprive local populations of their supplies, but the Government confirmed the decree, which takes into account the reports of experts that there is no danger of an exhaustion of supplies, and also of the guarantees offered by the city of Paris to construct reservoirs capable of storing 220 million cubic metres of water to be returned to the river Loire in times of drought. Now that the apparently inexhaustible supplies from the Vals de Loire are available for Paris, there is no further interest in the reservoirs that are being constructed on the upper reaches of the Seine with the object mainly of regulating the river and preventing floods, work on which appears to be proceeding very slowly. In the existing Paris supplies unfiltered river water is employed for town cleaning, and as there is a risk of its being used for drinking, all this water is henceforth to be sterilised with chlorine, for which purpose plants are being put down at the Ivry and Saint-Maur pumping stations. All over the country further progress was made with the suppression of wells and the supply of spring or filtered water to communes and villages, and, in addition to the annual State grant, a considerable sum out of the funds which had been voted by Parliament for the carrying out of relief public works, will be devoted to an improvement in the national water supply. In the South of France there are often serious difficulties in obtaining supplies of water, and Toulouse during the year satisfied its needs by constructing two reservoirs at the sources of the Ragas.

Kano (Nigeria).

The waterworks which had been under construction for the Kano Native Administration since December, 1929, were formally opened on February 21st, 1931, by the Lieut.-Governor, in the presence of the Emir and a large gathering, but the actual handing over to the Administrative Staff did not take place until July 1st last. The only work then outstanding was of a relatively minor character. The total cost of these works, which have been carried out by Administration under the direction of Sir Alex. Binnie, Son and Deacon is about £220,000. Mr. J. F. J. Reynolds acted as Resident Engineer in charge of construction at the site.

Singapore.

In connection with the supply to Singapore from Johore, of the progress of which we have given accounts in past years, the works of the second instalment were substantially completed and will be formally opened early this year. These works include the Pontian Kechil Reservoir, which is formed by a main and a subsidiary embankment impounding 3200 million gallons of water, of which some 2000 million gallons are now in storage; a pumping station which is equipped with three sets of Premier oil engines of 350 B.H.P., each driving Hathorn-Davey three-throw ram pumps as an initial instalment; an electrically-welded mortar-lined steel rising main, by which the water is conveyed to the aeration tank at Gunong Pulai; and an aeration tank. This work is being carried out by administration under the direction of Sir Alex. Binnie, Son and Deacon, the Resident Engineer at Singapore being Mr. G. B. Gfford Hull.

Other Places Abroad.

Shanghai has for some years past been engaged on increasing its water supply by installing a further river intake and additional sedimentation and purification works. The whole undertaking was described in our issues of December 18th and 25th last. A most able report regarding the investigations as to the best source from which to obtain an additional supply of water for Durban was presented by the town's Water Engineer during the year. This report was summarised in our issue of December 25th, 1931. Briefly stated, the most favoured scheme is the formation of a reservoir in the Umgeni River at a point where the stream makes an S bend, so that it is an easy matter to by-pass flood waters without allowing them to enter the reservoir. There would have to be a pipe line, 36 miles long, and the cost of the first portion of the scheme, which would furnish a daily supply of 15 million gallons, is estimated to be £1,181,103. During the year, too, a proposal was put forward to provide a supply of potable water for Moose Jaw, Regina, and some other towns of South Saskatchewan at an estimated cost of about 16,000,000 dollars. The Rand Water Board is carrying out the necessary works in order to abstract and purify an additional 5,000,000 gallons of water from the Vaal River. Montreal decided materially to increase the power of its waterworks pumping plant. The Municipality of Satara, in the Bombay Presidency, decided to carry out a scheme for improving the water supply to the town and the adjoining cantonment at a cost of 2·34 lakhs of rupees. The scheme, it is understood, would ensure the provision of 600,000 gallons a day. It was reported from Vancouver that it had been decided to drive a tunnel 7ft. 6in. diameter and 3200ft. long to convey water beneath the sea to the town from Capitans Creek. At present, the water is taken in submerged pipes, but that method is regarded as involving the risk of pollution. The tunnel is to be 400ft. below water level and the cost will, it is stated, be some 2,000,000 dollars. Athens initiated a new supply of water from the Marathon reservoir, being taken to the city through a tunnel 7½ miles long. It was decided to construct a large covered reservoir on the Plains of Abraham for the provision of an additional supply of water to the City of Quebec. The reservoir is to be 780ft. long, 310ft. wide and 20ft. deep. Those dimensions represent a capacity of over 30 million gallons. It is proposed to spend £100,000 on a waterworks scheme for Wuchung in Central China. The daily capacity is given as being 4,500,000 gallons. Still another proposal brought forward during the year was that by which it is suggested to construct an embankment 12 miles long, and with an average height of 20ft., at Sangywa, Rangoon, with the object of forming an artificial lake to provide potable water for the city. It is estimated that a volume of 47½ million gallons would be made available.

Physical and Optical Societies' Exhibition.

No. II.*

ONE of the most interesting current-measuring instruments was the Crompton "Tong Test" ammeter, shown by Crompton Parkinson, Ltd., of Chelmsford. Hitherto, the only meters for measuring A.C. without making an electrical connection with the circuit have been those operated from a scissors-type split-core current transformer, and the Crompton "A.C. Test" instrument. The current transformer method, the makers of the "Tong Test" instrument point out, involves the use of a moving iron or hot-wire instrument, and when more than one range is required, it is necessary to provide the transformer with two or more secondary windings, or with a variable air gap to raise or lower the magnetic reluctance of the iron circuit. But the Crompton "A.C. Test" instrument avoids the necessity for a current transformer-operated indicator, and—by the elimination of windings—reduces the possibility of electrical failure. Owing to the size and arrangement of the "A.C. Test" instrument, however, it is difficult to use it on conductors in awkward positions, and Crompton Parkinson have, therefore, produced an instrument of more convenient form, but which operates on the same principle. It is light and convenient to use, and, as shown in Fig. 11, it can be

FIG. 11—"TONG TEST" AMMETER—CROMPTON

operated with one hand. As the flux operates directly on the instrument movement without the intervention of a current transformer, the instrument can be used for measuring A.C. or D.C., and the range can easily be altered by changing the detachable movement, as indicated in Fig. 12. Contrary to what might be supposed, readings can be taken on D.C. circuits even if the cable is of the single-core, armoured type, or is run in a steel conduit. Another noteworthy point is that the magnetic reluctance of the butt joint is so low in comparison with that of the movement gap that small variations due to dirt, &c., have practically no effect on the accuracy of the indications.

The iron ring will take cables up to 1⅛in. diameter; the weight of the instrument complete is 2¼ lb. The magnetic circuit consists of two equal packs of iron stampings, one of which is rigidly fixed whilst the other is hinged to a die-cast frame composed of an aluminium alloy, and the cores are mounted to form an iron ring with two gaps, one with a well-machined butt joint and the other a specially shaped gap in which the iron movement operates in sapphire jewel bearings. The movement is contained in, and is integral with, a sealed bakelite housing and is fitted with an effective pneumatic damping device. It is held in position on the aluminium frame by spring clips, and is registered in the correct position by dowel pins. By means of a handle and simple trigger mechanism the instrument can readily be applied to a cable in the manner shown, and when the trigger is released and the two outer ends of the core are brought together, the meter immediately gives the reading. Movements are manufactured to give maximum readings of 50, 100, 150 and 200 amperes, the first scale marking in each case being one-tenth of the maximum reading. As the movement units are detachable and mechanically interchangeable, if two or more units are purchased, a multi-range instrument is obtained. The scale of the "Tong Test" instrument is 2⅜in. long. On A.C. circuits the accuracy is within the limits of error specified in B.S. No. 89, 1929, for first-grade instruments, whilst, if on a D.C. circuit the trigger is pressed and released so as to open and close the iron ring immediately before the

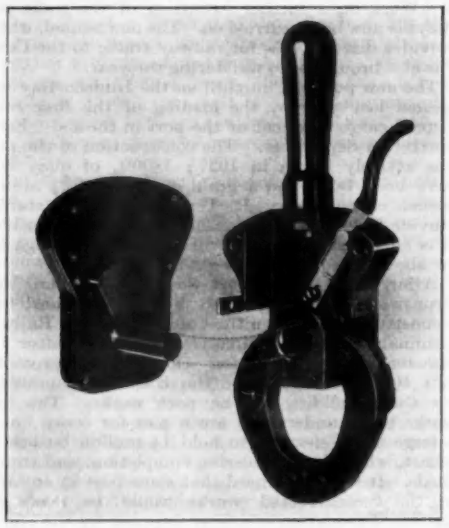


FIG. 12—AMMETER WITH MOVEMENT REMOVED

reading is taken so as to reduce the error due to hysteresis—which may otherwise be considerable if the value of the current is slowly rising and falling—second-grade accuracy is obtained.

The exhibits of A. Tinsley and Co., of Werndee Hall, South Norwood, S.E. 25, consisted of geophysical apparatus, a cable-testing set, a current transformer testing set, a Thomson-Varley potential divider, attenuators suitable for measuring amplification and attenuation in audio-frequency networks, a radio-frequency resistance box, and a multi-range ammeter for the measurement of high-frequency A.C. The latter instrument, which was designed by Dr. Barlow, accurately measures small alternating-currents of any frequency from 25 up to 6×10^8 cycles per second, and is particularly useful when a low-impedance circuit is desired. The disadvantages which usually accrue from the square law scale are

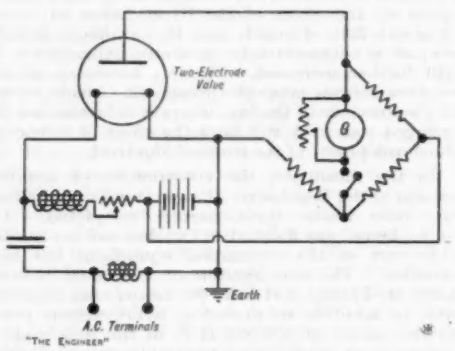


FIG. 13—VALVE AMMETER—TINSLEY

practically eliminated by the use of the multi-range switch. Both the range and the overload capacity of the apparatus are very much larger than that of the corresponding thermal couple type of instrument. The circuit, which includes a two-electrode thermionic valve, is shown in Fig. 13. The ability of the arrangement to measure small alternating-currents depends upon the very rapid increase in the saturation current taken from the filament of the valve with small changes in the filament temperature. In the first place, the valve filament is heated to a temperature somewhat below its normal working value by a battery of about 8 volts connected in series on the positive side, with a small variable resistance and a choking coil of high inductance and sufficient resistance to reduce the potential difference across the filament to 1 or 2 volts. The positive terminal of the battery is also connected to a system of resistances forming a bridge network, the fourth arm of which consists of the inter-electrode resistance between the anode and filament of the valve. A sensitive galvanometer is joined in the

* No. I. appeared January 8th.

usual way across the diagonal points of the bridge circuit, and the resistances are fixed so that the galvanometer shows no deflection when the filament of the valve is heated with D.C. Small deviations from this condition of balance due to room temperature changes, &c., can be readily corrected by means of the small variable resistance in series with the battery. The potential applied to the anode should be sufficient to take the saturation current from the filament.

The A.C. to be measured is now superposed on the D.C. passing through the filament. For that purpose the A.C. is fed through a condenser of large capacity—for example, an electrolytic condenser of 1000 microfarads or more—so that not only is the D.C. prevented from getting back into the A.C. supply, but the impedance of the A.C. circuit through the filament at frequencies as low as 25 cycles per second is not materially increased by the presence of the condenser. A choking coil of high inductance—for example, 20 henries—is connected directly across the A.C. terminals. This choking coil does not by-pass any appreciable part of the A.C., but has the effect of allowing a steady charge to be maintained on the condenser whether the A.C. supply circuit is closed or not, as is desirable when employing the electrolytic type of condenser. Moreover, with this arrangement, the closing or opening of the A.C. supply circuit does not cause any transient disturbances of the galvanometer. The other choking coil in series with the battery prevents the A.C. from finding its way into the D.C. part of the circuit. The effect of the A.C. superposed on the D.C. through the filament of the valve is to increase the temperature of the filament thereby causing an increase in the anode current and upsetting the balance of the bridge network, the galvanometer in the bridge circuit being calibrated to give a direct reading of the A.C. In assembling the apparatus, the negative side of the filament is earthed, and the capacity to earth of the positive side, along the path of the A.C., is made as small as possible.

Alternating-currents varying over a wide range can be measured with the same apparatus simply by using shunts across the galvanometer. The smaller the D.C. through the filament relative to the normal rated value for the valve, the more extensive is the range of A.C. that can be measured. The D.C. to the filament must, of course, be maintained constant, so that, prior to the injection of the A.C., the anode takes a definite saturation current from the filament. It has been found that a local accumulator battery, or even a dry battery, gives perfectly satisfactory results. Although the adjustable resistance in series with the battery may have to be used to set the galvanometer to zero before applying the A.C., it has been found that the sensitivity of the device as a measuring instrument remain substantially unchanged. An instrument covering a range of considerably smaller A.C. is now in course of construction.

A simple and very compact arc lamp with no moving parts, for small projectors, enlarging lanterns, spectroscopy, microscope lamps and for other purposes demanding a small but intense source of light

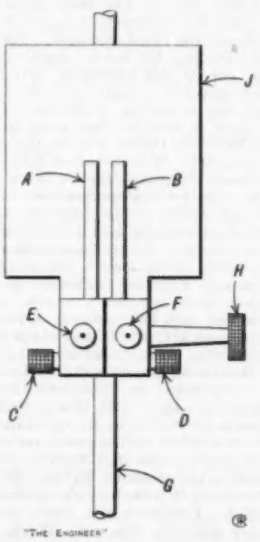


FIG. 14—SMALL ARC LAMP—BELLINGHAM

was shown by Bellingham Stanley, Ltd., of 71, Hornsey-rise, N. 19. The wandering of the arc from side to side—the greatest drawback to the use of arc lamps—is said to have been entirely overcome by the use of special alloy electrodes in the form of parallel rods. The difficulties frequently encountered with automatic or hand-feed arc lamps due to corrosion of the moving parts are eliminated, while the large space occupied by their mechanism is saved. The lamp is designed to burn the makers' special alloy electrodes, giving a spectrum considerably richer in ultra violet rays than that of the tungsten arc. The two electrodes A, B—Fig. 14—are parallel to each other and clamped in insulated holders by screws C, D. Terminals E, F are provided for connection to a source of D.C. of 3–5 ampères. The lamp unit slides on a ½in. diameter rod G, and is secured by a screw H at any height desired. A horizontal adjustment can be supplied if called for. If it is desired to use the light on one side only, an asbestos shield J is fitted behind the arc. A metal rod in an insulated handle is provided for starting the arc by momentarily joining the ends of the electrodes with the rod. The arc will then burn steadily across the ends of the electrodes with a small but intense flame, needing little attention. The special alloy electrodes burn away very slowly. The overall dimensions of the lamp unit using electrodes 3in. long are: height to top of electrodes, 3½in.; width, 2¾in.; depth, 2½in.

Mr. G. Bateson, of the Forest Products Research Laboratory, Princes Risborough, Bucks., was exhibiting a direct-reading humidity meter operating on the wet and dry-bulb principle. The wet and dry-bulb thermometer, Mr. Bateson explains, is generally accepted as the most reliable instrument for measuring relative humidities, particularly when the variations in temperature may be considerable; but the disadvantage of the usual type of hygrometer operating on the wet and dry-bulk principle lies in the fact that reference to tables or a chart is necessary before the relative humidity can be determined. Quite apart from the time and labour involved, there is the risk that the determination may be made incorrectly, as it is nearly always necessary to subtract the wet-bulb reading from that of the dry-bulb in order to obtain the difference on which the tables are usually based. Unskilled people often make mistakes in determining this difference and are usually incapable of interpolating the result if the figures obtained lie between those actually shown in the tables. The instrument exhibited was designed to obviate this disadvantage by indicating the relative humidity direct, while at the same time retaining the wet and dry-bulb principle and relating the two readings with as little complication as possible. The basis of the design is the humidity nomogram, which consists of a dry-bulb temperature scale, a parallel wet-bulb temperature scale and an intermediate humidity scale. The two temperature scales are marked off in opposite directions; in other words, the zero position on the dry-bulb scale is opposite to the maximum position of the wet-bulb scale, and *vice versâ*.

The nomogram is read by using a straight edge to intercept the dry and wet-bulb temperatures, the humidity being read off at the point of intersection

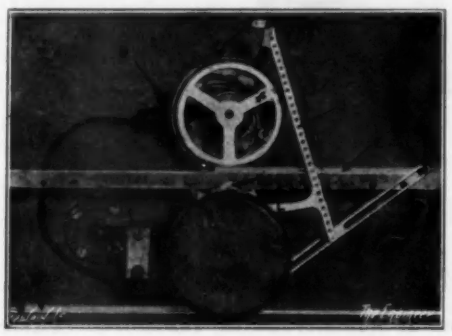


FIG. 15—HUMIDITY METER MECHANISM—BATESON

of the humidity scale. The instrument exhibited is virtually a mechanical nomogram of simple construction. The two thermometers A and B, Fig. 15, are standard mercury-in-steel, Bourdon-tube, dial-type, distance thermometers, manufactured by Negretti and Zambra, and, in place of the usual pointer, each carries a duralumin pionion C about 3½in. diameter. These pinions engage with two duralumin racks D and E, running parallel to each other on small ball races. The thermometers are so arranged that—for an increase in temperature—one rack is propelled in the opposite direction to the other. The two racks are connected together by an aluminium link F, equal in length to the diagonal of a rectangle having a length equal to the stroke of the racks, the breadth being the distance between the racks. The bottom end of the link is pivoted to the bottom rack—in this case the dry-bulb rack—while the remainder of it is slotted to take two rollers, one roller G being mounted on a spindle attached to the upper, or wet bulb rack, and the other H rotating on a spindle, tapped into the bottom end of a duralumin radius arm J, pivoted at K, which carries a quadrant L. The quadrant has teeth cut on its inner radius, which engage with a pinion M mounted on a spindle which carries the humidity pointer. It will be seen that the diagonal slotted arm F corresponds to the straight edge used in reading the nomogram.

It has been found that the humidity curve of the nomogram is sensibly an arc of a circle, and the radius arm J is made equal in length to the radius of the particular humidity curve suiting the dimensions of the instrument. Consequently, the roller H is constrained to move in the path of the humidity curve, and as the racks move, it will slide up or down the slotted diagonal member F. If the two thermometers are at the same temperature—*i.e.*, if the humidity is 100 per cent.—the end of the radius arm J will remain at the centre of the diagonal of the rectangle formed by the two racks D and E. The diagonal will, of course, vary in length according to the position of one rack relative to the other, but directly the wet-bulb temperature falls below that of the dry, the diagonal member will start to rotate the radius arm, which in turn will rotate the humidity pointer through the medium of the quadrant and pionion.

Theoretically, the instrument agrees almost exactly with the tables on which the nomogram is based. In practice, the instrument, which was exhibited, has a maximum error of slightly under 3 per cent., in a range of 40 deg. to 95 deg. Cent. and 100 to 20 per cent. humidity. Under test in a timber-drying kiln, the instrument has been found to compare favourably with the commercial two-pen wet and dry-bull recording thermometer.

The ring balance flow meter shown in Fig. 16 was

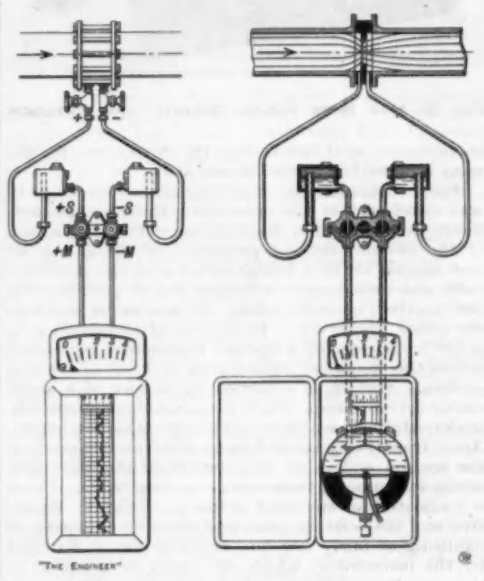


FIG. 16—FLOW METER—DRAYTON

one of the exhibits of the Drayton Regulator and Instrument Company, of West Drayton, Middlesex. The instrument measures the flow according to the pressure drop across an orifice, the differential pressure being measured, in the case of steam, by a mercury-filled balance in the form of an annulus, pivoted on a knife edge at its centre. The balance is loaded by a weight which is suspended in such a way that the deflection of the ring balance is proportional to the square root of the differential pressure across the orifice, and so gives deflections directly proportional to the flow. The ring balance deflecting clockwise causes the steel band on which the weight is suspended to bear on a cam at a point differing according to the deflection, and the cam is so shaped that the leverage on which the weight acts is varied so as to produce the desired characteristics. The ring balance is connected by means of a number of coils of steel tubing to unions fixed to the casing. By the use of more than one weight, the measuring range can be varied within wide limits. The instrument illustrated indicates as well as records the flow. The record is obtained on a tape chart and a twenty-four-hour record is visible, with a feed of ¾in. per hour. The feed can, however, be varied to suit requirements. The proportional movement permits electric integration to be obtained by the simplest means. High accuracy can be maintained indefinitely without recalibration. If the instrument is required for low-pressure air and gas flow measurement, an annular balance of much larger cross section is employed, and the connecting tubes are composed of rubber. Oil is also used as filling liquid instead of mercury. The instrument can be employed equally well as a sensitive pressure or differential pressure gauge.

Griffin and Tatlock, Ltd., of Kemble-street, Kingsway, W.C. 2, were showing a number of their products, including apparatus for the determination of oxygen

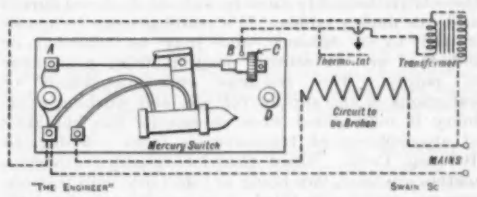


FIG. 17—HOT-WIRE RELAY—GRIFFIN AND TATLOCK

in water, a continuous gas indicator, an electrically-heated oven, and the simple hot wire relay shown in Figs. 17 and 18. The mercury switch of the relay is operated by the expansion and contraction of the wire A B, which, when the current is switched off, is sufficiently taut to pull the switch up and make the

mercury contact, the wire being adjustable by means of the knurled nut C. At the Exhibition the relay was controlling the temperature of an electrically-heated oven, the supply of current to the wire A B being controlled by a thermostat in accordance with the temperature. When the supply is A.C. the thermostat is connected across the secondary of a small transformer, as shown in Fig. 17; whilst if the relay is used on a D.C. circuit a lamp resistance

FIG. 18—HOT-WIRE RELAY—GRIFFIN AND TATLOCK

is employed, as shown in Fig. 18. Spare wire for the relay is carried on a spool shown at D.

The continuous gas indicator shown in Fig. 19 was developed in the Admiralty Research Department, and its action depends upon the comparison of the viscosity-density properties of the gas under test against air in a bridge comprising two capillary-tube and orifice plate combinations in parallel with one another, one side taking the gas under test and the other taking air. Indication of composition is made by means of a special manometer connected across the chambers immediately in front of the two orifices. Suction is obtained by means of a small motor-driven pump, which is operated automatically under extremely sensitive and highly stable conditions. Apart from the motor and pump which merely produce the suction and in no way determine the indication of the instrument, there are no moving parts. There is no heating of any kind in the gas streams. Corrosive and dissociating gases and gases decomposing or oxidising at fairly low temperatures can be handled by the instrument, which can easily be adapted to the sampling of gases at high pressures. The sensitivity is said to be very high. With two gases having their physical properties as nearly alike as nitrogen and oxygen, a 1 per cent. change in composition of their mixture produces a vertical manometer movement of over 2 mm. of water, whilst 1 per cent. of petrol vapour in air produces a movement of about 140 mm. Readings are said to be reliable to within

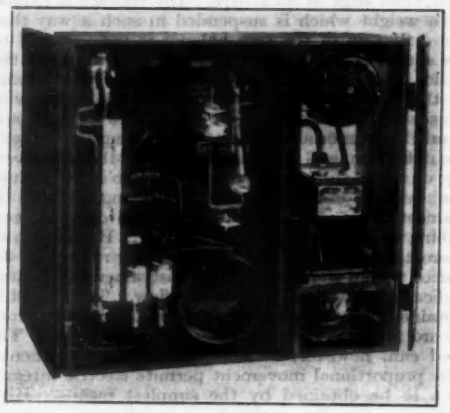


FIG. 19—GAS INDICATOR—GRIFFIN AND TATLOCK

at least ½ mm., and the indication is continuous. In slightly modified forms the instrument has numerous applications.

On of the most interesting exhibits on the stand of Elliott Brothers, of Century Works, Lewisham, S.E. 13, was the Siemens humidity meter, which works on the wet and dry bulb thermometer principle, and which, like the instrument described earlier, gives a reading of the relative humidity directly without the use of curves and calculating tables. The readings may be transmitted to a distance, and may be recorded or indicated at one central position from a number of points. The readings are independent of variations in the supply voltage, and working reliability is maintained when measuring the humidity of atmospheres at temperatures from —5 deg. to 100 deg. Cent. Three electrical-resistance thermometers are used, two being wet and dry bulb thermometers, whilst the third is an additional dry-bulb thermometer used for making the correction usually made by means of tables or curves. A special type of measuring system, which embodies a double or "cross-coil" movement and a double Wheatstone bridge, is used. A section through the transmitter is shown in Fig. 20. A small fan, driven by an electric motor F, draws the air or gas under test, first over two air thermometers C of the resistance element type, then through the curved tube H, and finally over the wet thermometer D, which is kept moist by a tightly-fitting cotton stocking, the end of which dips into a trough of water B inside the case of the instrument. A are screwed lugs for supporting the transmitter in position. Although it is possible to keep the container filled with water by hand day by day, it is desirable in warm atmospheres, to connect the transmitter with the water supply and to adjust the over-

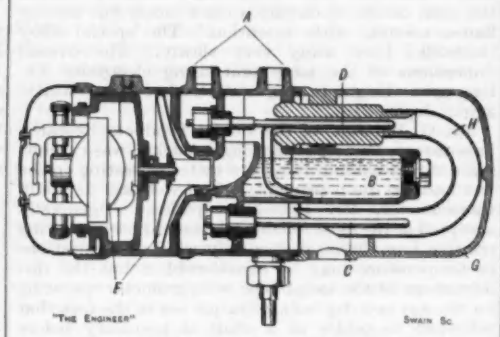


FIG. 20—SIEMENS HUMIDITY METER—ELLIOTT

flow to drip continuously. In atmospheres of about 40 deg. Cent., about 10 cubic inches of water evaporate daily.

In rooms or chambers with a temperature greater than 40 deg. Cent., the motor and fan must be separated from the transmitter and installed outside the room, a connection being made through the walls by a suitable tube having a maximum length of 15ft. If the air is moving rapidly, and there is sufficient pressure, it is possible to dispense with the motor and fan, when a special inlet tube is provided, as shown in Fig. 21, but, in that case, it is advisable to place the transmitter in a position where the pressure is not varying greatly in order to keep the rate of flow of air or gas as constant as possible. For use in large gas mains, another type is available, which is fitted with a flange to enable the whole transmitter to be installed inside the pipe, the water and electrical connections being brought through the flange. If it is desired to measure the humidity of several rooms at one central point, it is convenient to use an

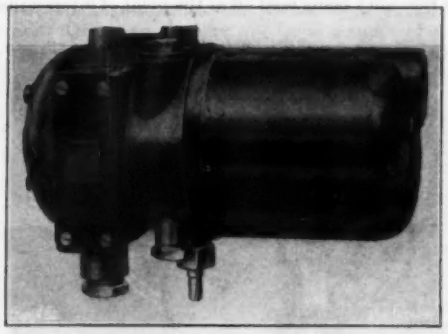


FIG. 21—HUMIDITY METER TRANSMITTER—ELLIOTT

indicator with a multi-way switch. It is also possible to read the room temperature, measured at the transmitter, on the same indicator by means of a switch, the indicator being provided with a double scale. No extra thermometers are necessary. If desired, a recorder may be used in place of an indicator, and one-way, two-way, and six-way types are available. The relative humidity at six measuring positions can be simultaneously recorded on one chart by a six-colour recorder, or, alternatively, three humidities and three temperatures or other combinations.

(To be continued.)

A New Light Alloy.

A NEW alloy known as "M G 7" and protected by patent rights, is composed mainly of aluminium in combination with magnesium and manganese in such proportions as to produce a material having a specific gravity of only 2·63, whilst its mechanical properties are similar to those called for by the B.E.S.A. specifications for "duralumin." The principal physical properties of this alloy are:

Specific gravity	2·63
Annealing temperature	380 deg. Cent.
Forging temperature	400–420 deg. Cent.
Fatigue range	±9·5 – ±10·25 tons per sq. in.
Brinell hardness	90–115
Izod impact value	17 foot-pounds

In the rolled form the alloy is stronger than rolled and heat-treated duralumin; in the form of bars and forgings the strength is some 2 or 3 tons lower than that of duralumin, whilst in the form of tubes its strength is practically identical with that of heat-treated duralumin. The metal is not capable of heat-treatment, and variations in its strength can only be brought about by the application of differing amounts of cold work.

The results of actual tests taken from the metal in different conditions given to us are as follows:—

	Proof stress. Tons per sq. in.	Max. stress.	Elongation, per cent.
Annealed	11	22	20
Rolled or drawn	19	25	12
Hard rolled	25	29	6

The annealed test results apply to material in any of the standard wrought forms. The hard rolled test values can only be obtained on sheets and tubes of normal wall thickness, but the second set of test values apply to sheets in the ordinary way and to bars of a size not greater than about 2in. diameter.

The application of cold work to the material hardens it fairly quickly, and since the initial strength of the metal is high, the amount of working and shaping that can be applied before it becomes too hard is comparatively restricted; but it can be re-annealed and worked further, and as it has a very considerable toughness, it can, by suitable means, be shaped quite satisfactorily, and as it contains no copper it can be welded.

The resistance of the material to corrosion, particularly that of the atmosphere and more especially of sea water, is extremely high, and it is entirely free from liability to intercrystalline corrosion. It is well known that the effect of corrosive agents upon metals is to reduce very markedly the elongation per cent., and usually also to bring about a marked reduction in the value of the maximum stress of the material.

In the following table, results obtained by James Booth and Co., Ltd., of Argyle-street, Birmingham, who are making the new material, are roughly summarised:—

Time of exposure.	Max. stress, tons in.². MG7.	Elongation, per cent. MG7.
0	28·5	6
Five weeks	28·2	5
Ten weeks	28·7	6
Fifteen weeks	28·7	7

SIXTY YEARS AGO.

SOME brief, but engaging pen pictures of the old-time "iron kings" of South Wales are to be found in a note on Crawshay Bailey in our issue of January 19th, 1872. There was Richard Crawshay, of Cyfarthfa, the patriarch of them all, a tall well-built Yorkshireman, deeply marked with small-pox. We picture him with his hands deep in his vast breeches pockets, rattling his beloved spade guineas, and surveying from his big house the huge undertaking which his genius had called into being. Among his workmen we see George, a simple carpenter, but a man of grit, who, having made the largest water-wheel the world had ever seen, left Cyfarthfa to found the Monmouthshire tin-plate trade. There, too, we see Wayne and his brother, who left to begin iron-making in Monmouthshire, and who later originated at Aberdeen the sea-coal trade. Among their companions at Cyfarthfa we see also the youth Benjamin Hall, who was to become Lord Llanover; Hill, afterwards of Plymouth; and Forman, afterwards of Penydarran. In the rear are two lads, Joseph and Crawshay Bailey, who, with the initial assistance of Wayne, later on established the Nantyglo Works. The brothers were blunt, outspoken men, with little literary ability and many eccentricities. Picture Sir Joseph, with his hatred of smoking, seizing the pipe from the mouth of a stranger whom he met in his park, trampling it in a passion beneath his feet, and then, the fit over, talking rationally as if nothing had happened. Crawshay Bailey had his own share of the family character. By some he was thought mean, but he had been known to give an order for the erection of a church or school, and to pay the whole bill without the least concern. Rarely carrying money in his pockets, he would frequently borrow a sovereign from one of his workmen, and some months later pay it back with a five pound note and a sound rating for not asking him to return it before. The Nantyglo Works at one time in their history were on the verge of bankruptcy. Crawshay Bailey was on the road to Abergavenny with the difficult task before him of persuading the bank to advance the money for his men's pay. He was overtaken on the way by a messenger with the joyful news that coal had been struck on his property. Gold began to rain in upon the undertaking, and it continued to pour for many a day thereafter. Bailey soon found it necessary to establish a bank of his own. His notes, of a very primitive character, with his signature scrawled at the foot as if with a stick, seemed to invite counterfeiting. There was, however, only one instance on record of a false note getting into circulation. It was taken in the way of trade by a Jew who, discovering its nature, demanded recoupment. He accompanied his demand with the threat that if it were not granted, he would ruin the future circulation of the genuine notes. But it was almost as foolish to threaten Crawshay Bailey as to compliment him. He refused the Jew's demand, and the only satisfaction which the victim ever received was that derived from exhibiting the note, framed, in his window. In later life the brothers bought the Aberaman Works, but the speculation was not wholly successful. Following the death of his brother, Crawshay Bailey sold the Nantyglo Works, and retired with a fortune, some said, of £4,000,000. His health was, however, already failing, and he lived only a short time to enjoy the seclusion of his manorial estate. With him died the last of the old iron kings. The youthful efforts and humble essays conducted by men of little means but of great energy and ability, had at the close of the eighteenth century begun an industry which, starting like a small mountain rill, was by the middle of the nineteenth century to expand into a broad, ample and useful river. With words to that effect we closed our note on Crawshay Bailey's life sixty years ago.

IT is proposed to put up a boot and shoe factory on the north bank of the Thames in Lower Hope Reach, with a capacity of 150,000 pairs a day. The promoter is Mr. T. Bata, of Zlin, Czecho-Slovakia.

Railway and Road Matters.

As long ago as 1885 the Pullman Company provided a first-class sleeping car between Inverness and Glasgow and *vice versâ*. In 1904 this service was taken over by the Highland Railway, in conjunction with the Caledonian, and on grouping it became part of the L.M.S. through services.

THE first meeting of the Departmental Committee, presided over by Sir Henry Maybury, on Traffic Signs was held on Wednesday, the 6th. In addressing the members, Mr. Pybus, the Minister of Transport, said that in the work there was enormous scope for inventions and ideas; it was a fascinating job, and the members would see that the terms of reference gave them a very free hand.

THE Ministry of Transport railway statistics for October have recently been published as a Stationery Office publication, price 2s. 6d. They show that, compared with October, 1930, there was a decrease of 4·6 per cent. in the number of passenger journeys and of 9·3 per cent. in the receipts from passengers. The passenger train mileage decreased by 1·1 per cent. Goods traffic suffered a drop of 7·8 per cent. in tonnage and of 8·4 per cent. in receipts, whilst the goods train mileage was decreased by 4·7 per cent. The average train load fell from 128¾ to 124¼ tons and the net ton-miles per engine hour from 459¾ to 452¼.

MR. C. A. ROWLANDSON, whose death occurred on January 2nd, had a varied experience up to the time—in 1896—when he succeeded Mr. Alexander Ross as chief engineer of the Manchester, Sheffield and Lincolnshire Railway—later the Great Central—from which position he retired, on reaching the age limit, at the end of 1911. The first five years of his business career were spent on general engineering in India, and then, in 1882, he began his connection with Sir Douglas Fox, for whom he acted on the construction and equipment of the Mersey Railway and, some years later, as resident engineer for the London end of the Great Central extension to London.

IN accordance with our usual custom, we record here that the number of train accidents last year in which passengers lost their lives was four—Carlisle, January 3rd, three killed; Leighton Buzzard, March 22nd, three killed; Feckenham, May 27th, one killed; Dagenham, December 18th, one killed. The worst year, as regards the number of fatal train accidents, of the present century was 1915, when there were eight; the next worst was the six of 1928, and the next were the four of 1927 and of last year. The eight passengers who lost their lives last year was a more favourable number than the average, as only in nine years of the century has it been less than eight.

IN a New Year message to the staff of the London, Midland and Scottish Railway, the chairman and president, Sir Josiah Stamp, says:—"The (railway) situation, therefore, everywhere demands the greatest alertness of mind to move with the times and the greatest resolve to serve the public in the best possible way willingly and efficiently. Our great machine needs to be of the best physical and human material in every part and to be lubricated with good will and a sense of corporate interdependence. Above all, we need to keep up our courage and to be undaunted by the difficulties ahead of us. With this resolve we shall win through and prove to the world that railways are as capable of rendering vital service to the community as ever in history."

Two important statements are made by Sir Herbert Walker, general manager of the Southern Railway, in the *Railway Newsletter* for January. The first says that when conditions improve and the financial position is such as to warrant development in the railway industry, it is almost certain that the electrification of railways will be proceeded with; but it is most unlikely that this will take place in the wholesale manner foreshadowed in the report of the Weir Committee. The second statement anticipates that when the complete figures as to the financial results in 1931 are presented to the shareholders it will be found that, though the receipts will be between £14,000,000 and £15,000,000 down, the companies have made strenuous efforts to combat this loss and that considerable savings have been effected.

THE Board of Trade export tables show that the value of railway material sent overseas during the first eleven months of the present year was as follows; the corresponding figures for 1930 and 1929 are added in brackets:—Locomotives, £1,491,674 (£3,576,879, £2,971,833); rails, £811,650 (£2,044,648, £2,534,812); carriages, £1,109,112 (£1,725,535, £2,218,259); wagons, £915,327 (£3,004,890, £2,270,735); wheels and axles, £166,423 (£362,573, £397,580); tires and axles, £296,461 (£612,436, £569,086); chairs and metal sleepers, £389,177 (£597,737, £479,072); miscellaneous permanent way, £409,637 (£806,892, £952,854); total permanent way, £2,115,532 (£4,524,813, £5,074,813). The weight of the rails exported was 98,565 tons (235,998 tons, 301,138 tons), and of the chairs and metal sleepers 50,070 tons (62,603 tons, 48,000 tons). Not a single locomotive was shipped in the month of November last. The rails sent overseas during November were of the value of £63,784, which included £51,053 for South Africa and £8147 for Portuguese East Africa.

A CENTENARY of December, 1831, was that of the Dundee and Newtyle Railway. It was sanctioned in 1826 and ran from Ward-road in Dundee, almost due north, to Newtyle, in the Vale of Strathmore, a distance of 10 miles 40 chains. There were three inclined planes worked by stationary engines. The line left Dundee on one of the inclined planes—the Law—which was 42 chains long, on a gradient of 1 in 10, and included a tunnel 330 yards in length. Nearly 5 miles farther on was Balleuchly inclined plane, 1690 yards long and rising 1 in 25. The third was Hatton inclined plane, which was 1025 yards long and fell, at 1 in 12¼, towards Newtyle station, which was at the foot of the third incline. Horses were employed on the level portions until locomotives were introduced in 1833. The gauge was 4ft. 6½in., but was made to the standard gauge in 1849. The line was acquired in 1864 by the Scottish Central and thus became part of the Caledonian system. The Balleuchly and Hatton inclined planes were subsequently displaced by diversions on a more favourable gradient, and the Law incline disappeared on the line being carried through Lochee to join the Caledonian Railway.

Notes and Memoranda.

AN extensive research into the efficiency of locknuts has been carried out by the American Bureau of Standards. In all forty-one devices were tested and are described in Research Paper No. 386, which can be obtained from the Superintendent of Documents, Washington, D.C., price 30 cents.

IN order to camouflage a water stand pipe in Scarsdale, New York, it has been encased with masonry resembling a Martello Tower. The tank is 54ft. in diameter by 101ft. high, and is made of steel. The granite casing is separated from the steel by a distance of 4ft., and in the interspace there is a spiral staircase.

A RATHER unexpected feature of high-speed flying was mentioned in a recent address by Mr. H. E. Wimperis, the Director of Scientific Research to the Air Ministry. He pointed out that at speeds above 360 miles per hour the rush of air actually heats, instead of cooling, a body by which it passes, which naturally complicates the cooling of both the engine and the pilot's cockpit.

IN the process of rebuilding the No. 1 dry dock at the Puget Sound Navy Yard, U.S.A., it was necessary to break a large amount of concrete with pneumatic drills. Three shifts were worked, and it is said that the continuous operation so fatigued the steel that frequent breakages occurred. The heat treatment of the points for their entire length, however, greatly reduced these breakages.

IT is pointed out in the *Railway Newsletter* that of the two types of "flying" junction, the "fly-under" is generally the better, as the speed acquired by running down the slope is counteracted by climbing the succeeding gradient, for, whilst with the "fly-over" the incline which has to be negotiated is, of course, followed by a falling gradient, it is not always possible to take advantage of it.

IN a paper read before the American Illuminating Engineering Society, Mr. R. E. Simpson has expressed the view that roughly 15 per cent. of industrial accidents in the United States, which occasion an annual loss of nearly £400,000,000, are attributable to inadequate lighting. He also quotes an instructive example of an accident due to inadequate lighting which led to incidental and uninsurable losses of £6000.

A MACHINE has been evolved by Professor F. Firestone, of the University of Michigan, for detecting surface flaws in metal objects. The object is revolved beneath a microscope and is illuminated by a beam of light. The light passing through the microscope is focussed on a selenium cell and varies if there is a flaw in the surface. The variation in the current in the cell thus produced is amplified and used to reject any objects which are faulty.

A SUCCESSFUL experiment in road-making has, says the *Iron and Coal Trades Review*, recently been carried out by the Shotts Iron Company, Ltd., on the main road to their Northfield Colliery at Shotts. The foundation of the road is formed by a layer of cast iron plates instead of the usual ballast. The plates distribute the weight of the traffic over a wide area, so lessening the risk of subsidence of the foundation. The plates are ribbed, giving increased strength, and also assisting the adhesion of the surfacing material, which may be tar macadam or any other material which is plastic when laid. Interlocking joints prevent displacement of the plates.

A CONSIDERABLE amount of research into the influence of intensity of illumination on production has taken place, specially noteworthy, in the opinion of Mr. J. S. Dow, being the investigations conducted by the Illumination Research Committee, on the effect of illumination on fine processes, such as typesetting by hand. In this case it was shown that full efficiency was only attained with illuminations of the order of 20–25 foot-candles, comparable with good daylight illumination in interiors, and the principle doubtless applies broadly to fine processes. It should not be assumed, however, that better lighting automatically ensures higher production in any factory, and it is perhaps inexpedient to present the principle in this form; it is better to say that good lighting removes drawbacks that handicap the worker and makes it possible for him to put forth his best efforts.

IN nine cases out of ten, according to Mr. Donald Gill, the aeroplane can best help the prospector by providing him with a mosaic of vertical photographs, with contact prints and with interpretation, based on them and on direct reconnaissance, both in the air and on the ground. In many cases where mineralisation is being looked for there will be already some sort of theory as to the "locus" of the mineralisation, and it will be the duty of the geologist carrying out the work to look from the air for signs of this "locus," whether it be zones of shear or a particular stratigraphic horizon or something else. All kinds of prospecting come down, in the end, to making holes in the ground, trenches, pits, adits or bore-holes, and in most cases all that geological work can do, whether from the air or otherwise, is to indicate the "most likely" places and so make a saving in the amount of searching and deadwork.

IN discussing communications and transport in relation to town and regional planning, before the Institution of Civil Engineers, Manchester and District Association, Mr. F. A. Rayfield said:—"With regard to the advantages of a single directional over a double directional highway, it is difficult and unsafe for vehicles travelling at night on the latter in opposite directions and on inside traffic lanes to exceed a speed higher than 30 m.p.h. In a wide carriageway containing, say, six traffic lanes—three in each direction—four of them would be unable to travel faster than 30 m.p.h., since the outside lanes near the kerbs are also restricted in speed, but the central lane in either direction might attain a safe speed of 40 m.p.h. In a wider carriageway higher speeds for intermediate lanes might be possible. If, however, the maximum speeds were permitted on the outside lanes, that is to say, if the rule for overtaking of one vehicle by another were reversed and this outside lane was nowhere interrupted by vehicular or pedestrian traffic, a possible average speed of as high as 60 m.p.h. could be obtained. It is obvious that in this case the ramps or other access lanes would have to be placed in the centre of the highway where the slowest main road lanes were situated."

Miscellanea.

RYE HARBOUR, it is officially stated, is not to be closed.

A FACTORY for the production of electric refrigerators is being organised in Hamilton, Ontario.

IT is proposed to construct a sewage scheme for the north side of Bombay at a cost of from Rs. 15 to 20 lakhs.

A DAM, 197ft. high, of the earth-fill type, is to be constructed across the San Diego River in California for providing potable water for the city.

IT is estimated that when the Cape Town air port at Windermere has been completed—it is nearly so now—it will have cost £50,000. The running expenses are put at £6000 a year.

THE British Colour Council, which has a membership of about 350 and held its first meeting on January 5th, is endeavouring to draw up a standard colour card with distinctive names for the various colours.

THE eighteenth British Industries Fair will be opened on February 22nd and close, at Castle Bromwich, on March 4th. The total area of the three sections amounts to 30 acres, and the stands alone in the heavy section have an area of 243,000 square feet.

IF the decision of the South African Railway Administration to increase the freight of coal by 10d. per ton is put into force, it will mean that the Cape Town Electricity Undertaking will have to pay about 26s. a ton for coal, of which 80 per cent. will be due to railway charges.

IN an effort to attract new industries to Sheffield, a Development Joint Committee under the City Council has been formed for an experimental period of three months. Major T. H. Howard, Secretary of the Intelligence Department of the Chamber of Commerce, is the organiser.

THE value of production in the wood-distillation plants in Canada during 1930 amounted to 1,195,936 dollars, as compared with 1,680,332 dollars for 1929. Three companies operated six carbonising plants and one refinery, with an aggregate capital of 2,263,181 dollars; 167 persons, who received in salaries and wages 160,928 dollars, were employed in the industry; the cost of material was 504,323 dollars.

DEVELOPMENTS are to be made at the New Hartley Hastings Pit, Northumberland, belonging to the Hartley Main Collieries, Ltd. There are still four seams of coal at the pit untouched, and these are expected to be opened on the completion of additional surface plant, which is necessary to deal with the larger output. All the colliery plant is to be electrified. Approximately 530 miners are employed at the colliery at the present time, and the average daily output exceeds 1500 tons.

AT the general meeting of the University and Research Section of the Library Association, held at University College, London, on January 9th, Mr. Arthur F. Ridley, secretary and librarian to the British Non-Ferrous Metals Research Association, delivered an address on "The Organisation of Intelligence Services," and explained the modern technique which has been developed for the supply of information to assist particular industries or firms carrying on technical or commercial enterprises.

IN order to provide a supply of tars of known origin for experiments, it is proposed to erect at the Fuel Research Station two intermittent vertical gas ovens of the latest commercial type. These will be arranged so that it is possible to employ a range of carbonisation temperatures between 600 deg. and 1000 deg. Cent.—that is, intermediate between those used in current low-temperature carbonisation and in gas retorts. It is thus hoped to find the optimum conditions of working in various circumstances.

AMONG the topical electrical power schemes in South Africa there are the extension of the power plant at Parys, by the addition of a 200 kW water turbine, taking water from the river Vaal, and a standby plant driven by heavy-oil engines. The scheme is estimated to cost £19,000. The electric power-house at Vryheid is to be extended at a cost of £32,000. Extensions at Pretoria are to cost £250,000; a scheme, to cost £5000, is planned at Fransch Hock, and the modernisation of the supply at Benoni will cost about £30,000.

THE report of the United Kingdom Trade Mission to Egypt, which was recently issued by the Department of Overseas Trade, includes a long list of recommendations. Amongst them we note: "The general level of cost in the United Kingdom is too high and must be reduced. A complete overhaul of our cost of production is more than due, and we feel that there is no time to lose. . . . In many lines British goods are too substantial and too good for customers, who value cheapness above quality, and want flashy designs and bright colours."

IT has, says the *South African Engineer*, been decided to postpone for the present the purchase of the 33,000-volt underground cable which was to have been laid early in 1932 between the two power stations at Durban, Natal, in order to give direct supply at that pressure from Congella to Livingstone-road sub-station in the Stamford Hill area, from which the cable has already been laid back to Alice-street power station. For the time being the step-up transformers will be installed in the latter station instead of at Congella. These transformers, six in number, each of 2500 kVA capacity, single-phase, have been purchased from the Hackbridge Electric Construction Company, Ltd.

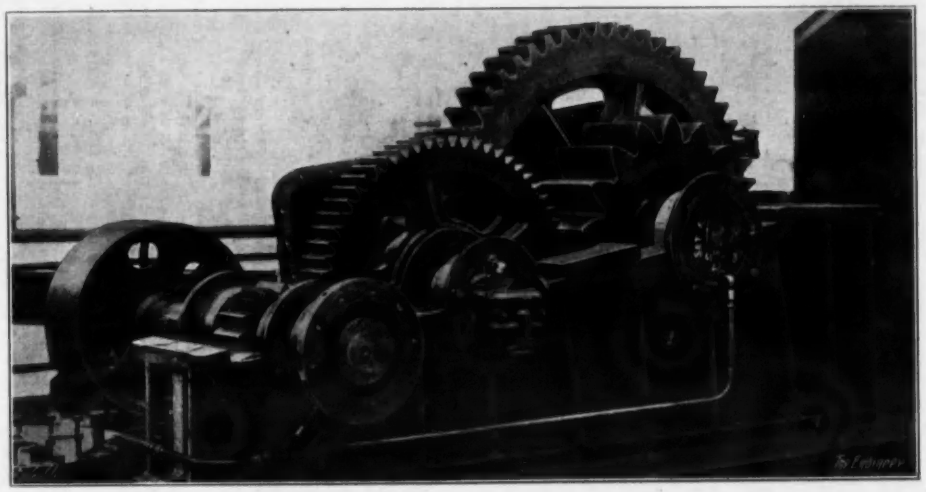
THE Chinese Ministry of Industries has organised a Planning Committee to be in charge of preparations for the establishment of the five proposed Government factories—textile factory, woollen mill, salt and sugar refineries and chemical works—according to the *Chinese Economic Bulletin*. Three sub-committees on scientific, metallurgical and textile industries have also been appointed to assist the Committee. In connection with the Ministry's plans for the opening of a central engineering works for the manufacture of machine tools, it is learned that the proposed works will have an initial capital of 3,000,000 dollars—say, £300,000. Steam boilers, marine engines, machines for road building and other tools will be produced.

GYROSCOPIC STABILISING EQUIPMENT FOR THE CONTE DI SAVOIA

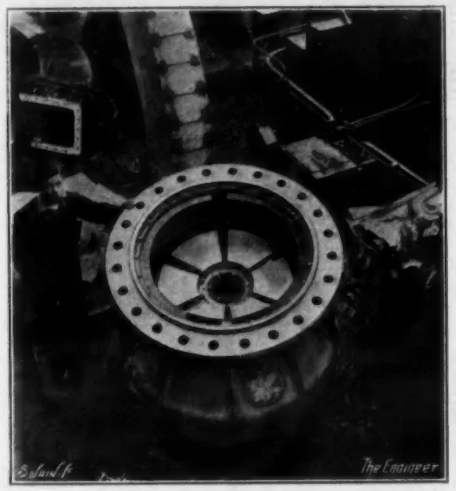
SPERRY GYROSCOPE CO., LTD., LONDON, ENGINEERS; VICKERS-ARMSTRONGS, LTD., AND METROPOLITAN-VICKERS ELECTRICAL CO., LTD., CONSTRUCTORS

(*For description see page* 62).

RADIAL BEARING FOR FLY-WHEEL



PRECESSION SPEED-REDUCTION GEAR TRAIN



MICHELL THRUST BEARING

SWITCHBOARD FOR ONE UNIT

MOTOR GENERATOR SET

The Engineer

JANUARY 15, 1932.

VOL. CLIII. No. 3966

Contents.

THE ENGINEER, January 15th, 1932. PAGE

A SEVEN-DAY JOURNAL .. 61
THE GYROSCOPIC STABILISING EQUIPMENT OF THE LLOYD SABAUDO LINER "CONTE DI SAVOIA." No. II. (Illus.) .. 62
HARBOURS AND WATERWAYS IN 1931. No. II. .. 65
WATER SUPPLY IN 1931 .. 67
PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION. No. II. (Illus.) 68
A NEW LIGHT ALLOY .. 70
SIXTY YEARS AGO .. 70
RAILWAY AND ROAD MATTERS .. 71
NOTES AND MEMORANDA .. 71
MISCELLANEA .. 71
LEADING ARTICLES—
British Marine Engineering .. 73
Science and Industry .. 73
French Steel Organisation .. 74
MODERN TYPES OF PROPELLING MACHINERY FOR MERCANTILE MARINE USE .. 74
SHIPBUILDING AND MARINE ENGINEERING IN 1931. No. III. (Illus.) .. 77
DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH .. 78
LETTERS TO THE EDITOR—
Profit Sharing—British Turbines on the Continent .. 79
NEW CONTROL GEAR FOR A.C. MOTORS. (Illus.) .. 80
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 81
Lancashire .. 81
Sheffield .. 82
North of England .. 82
Scotland .. 82
Wales and Adjoining Counties .. 83
THE QUARTER'S SHIPBUILDING RETURNS .. 83
CONTRACTS .. 83
CATALOGUES .. 83
CURRENT PRICES FOR METALS AND FUELS .. 84
FRENCH ENGINEERING NOTES .. 85
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 85
FORTHCOMING ENGAGEMENTS .. 86

SIXTEEN-PAGE SUPPLEMENT—INDEX TO VOL. CLII.
TWO-PAGE SUPPLEMENT—GYROSCOPIC STABILISING EQUIPMENT FOR THE LLOYD SABAUDO LINER "CONTE DI SAVOIA."

NOTICES TO READERS.

**** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

**** For Subscription rates see page 2 of Advertisements.*

**** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

**** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

BRITISH MARINE ENGINEERING.

THE fourth Thomas Lowe Gray Lecture, which was delivered by Mr. Sterry B. Freeman on Friday evening last at the Institution of Mechanical Engineers, dealt generally with the present position of propelling machinery for merchant ships. The assembled facts and information given by Mr. Freeman, some of which are reprinted elsewhere in to-day's issue, are complementary to those presented by Admiral Skelton last year in his lecture on Naval Engineering, so that the third and fourth lectures, when taken together, cover the whole field of marine engineering practice. As befitted the occasion, a large and representative body of engineers was present at the Institution on Friday, and we do not hesitate to say that had the lecture taken the form of an ordinary paper, a vigorous and instructive discussion would have followed. As that was not possible, it may be of value to consider some of the points raised by the lecturer, and to state the present position of the British marine engineering industry as we see it to-day. From the tabulated records given by Mr. Freeman illustrating the progressive reduction in the fuel rate of steamships in the last five years, it is satisfactory to note that British designs occupy a leading position for both oil and coal-fired steamers, while as regards motor ships no possible line of development has been neglected. If this spirit of unresting initiative be further pursued, we need have no fear of the future of British marine engineering, which, as regards technique, workmanship, and materials, occupies and retains by general consent the leading world position.

Representing as it does the whole field of mechanical engineering, THE ENGINEER is totally without any bias in regard to the means of propulsion of ships. There is abundant evidence that there is scope for all the known forms of propelling machinery, and that, at present, it cannot be safely said that any one is better, under all conditions, than the others. Mr. Freeman's admirable lecture might leave the impression that the oil engine was superior to the steam engine in all circumstances. In justice to steam, without doing any injustice to motor propulsion, of whose merits we are not in doubt, we put forward a few points which we deem worthy of consideration. Let us take first the figures given by Mr. Freeman for fuel consumption, which have for the most part already been recorded in published descriptions of steam and motor ships. Such figures, while they are of interest no doubt in showing chronologically the progress made, should not, in our view, be confused with the more important actual service results of similar ships on like runs. It is in the latter alone that we must seek true comparative values when assessing the relative merits of different types of propelling machinery. We find in the table small cargo ships of three to four thousand tons alongside Atlantic liners of more than ten times the tonnage and horse-power, with their added complexity of auxiliary machinery necessitated by a large hotel load. A similar disparity in machinery lay-outs, in designs, and in powers does not make possible any true comparison between the different types of turbo-electric ships mentioned in the lecture. The designs specially adapted for fast economical runs, varied service speeds, and long cruises at slower speeds often introduce, as Mr. Freeman says, an all-round commercial working efficiency which may be higher than that of a similar geared turbine vessel for a given service. In comparing ships, especially oil engine propelled vessels, the engine revolutions should always be given, as they are closely bound up with the question of propeller efficiency, and are equally important with machinery weight and fuel consumption when it is desired to compare the progressive development of different machinery types. Again, the criterion of engine-room length, without a knowledge of the height of the engine-room and uptake spaces, is insufficient, except perhaps for cargo vessels, to enable any useful relation to be established between the machinery spaces of different types of plant. We have particularly in mind the very low engine-rooms made possible by the use of quadruple-screw trunk piston oil engines in the "Reina del Pacifico," and the four shaft turbo-electric drive in the "Monarch of Bermuda" and the new "Queen of Bermuda," both of which arrangements allow considerable more cabin space to be put into the ships than would have been possible with other machinery lay-outs. Mr. Freeman emphasises the great height, 40ft. it may be, needed for the air heater of the modern water-tube boiler, but in the turbo-electric ships above mentioned the air heaters of the "Babcock" boilers are particularly neat in design and quite low. In any case, this essential feature of the modern water-tube boiler may be likened to the waste heat silencer boiler of the motor ship, which really forms a part of the funnel uptake. From investigations we have been able to make there is excellent reason for stating that modern designs of steam plant compare well with the newest motor ships as regards weight of machinery and the space taken up. The question of the relative merits of steam propelled and motor ships was not perhaps directly raised in the lecture, but the comparison of initial and running costs given in the Appendix do invite some comment. One of the most interesting sections of the lecture was that in which the ideal lay-out for a modern first-class steam-driven cargo liner was described. This machinery would comprise an 8500 S.H.P. installation of three-stage, single-screw, single-reduction geared turbines, working in conjunction with modern water-tube boilers, delivering steam at a total temperature of 700 deg. to 750 deg. Fah. The high efficiency of the single-screw relatively large-powered turbine would mean a reduced machinery weight. The fuel consumption of such an installation using pulverised coal would be in all probability not more than 0·9 lb. per S.H.P. hour for all purposes. This figure, having in view the present prices of coal and boiler oil fuel, compared with Diesel oil, in British and overseas ports, would make a very economical proposition from the operating point of view. We should have liked to see an estimate of initial and running costs given for this special lay-out of machinery beside the figures of the twin-screw installations included in the table given in the Appendix. In view of the well-known difference in oil engine costs for Continental and British engines, it would have been very useful if it had been stated whether the initial costs given in the table were computed on the basis of British-built machinery throughout, thus making them comparable with the turbine prices.

Speaking at the close of his lecture, Mr. Freeman seemed to hold out little hope for the continued use of British coal at sea, except by a development of the coal-dust burning engine, which as yet has only been built in small units and has yet to be installed aboard ship. That British shipowners and shipbuilders are still interested in coal-burning steamships is shown by the inquiries for ships mentioned in the lecture, the majority of which were for steamships, probably more than half of them coal-fired. The interest in improved forms of steam reciprocating engines is further evinced by the adjourned meeting at the North-East Coast Institution of Engineers and Shipbuilders on the 22nd of this month to discuss further the operating costs of such machinery. An immediate task would, as we see it, seem to be to develop further types of highly economical water-tube boilers which can be fired equally well with injected coal or oil fuel. High-pressure turbine machinery of light weight with a simple arrangement of auxiliary machinery requiring little attention in service has already been designed and perfected. Such a machinery installation on medium and large cargo-carrying ships would enable British owners to make effective use of our cheap coal supplies. In the past, foreign shipowners were attracted to British yards by the knowledge that they would obtain the best ships at strictly competitive prices. At the moment our prices are perhaps against us, but our reputation for high quality design and workmanship is fully recognised, and by the initiation of courageous designs we shall tend to restore prosperity to the shipbuilding industry. While we look forward to the development of every type of internal combustion engine, including the coal dust motor, we have every confidence that, when our shipping prosperity returns, steam will play an important part in maintaining the high operating efficiency of our world-wide mercantile fleet.

Science and Industry.

THE Sixteenth Annual Report of the Advisory Council of the Department of Scientific and Industrial Research opens with an essay, over Lord Rutherford's name, in which the value of research to industry is presented ardently, yet with a moderation and understanding which is not always found in the apostles of scientific progress. "There are those," it says, "who would urge us forthwith to recommend greatly increased State expenditure on research for the solution of industrial difficulties. In our view, such a development, without qualification, could not be defended. The expenditure which is defensible in the national interest depends on the degree to which industry generally is prepared to apply scientific method and advances in scientific knowledge. So long as we are convinced, as we are to-day, that industry is showing itself increasingly ready to make effective use of science, so long shall we be able to justify to the nation the policy of steady development to meet new needs as they arise which has guided our predecessors and ourselves since the appointment of the first Advisory Council in 1915."

This we hold to be the right and proper attitude for a national body, but we have no doubt at all that many will continue to charge the D.S.I.R. with luke-warmness. There are not wanting those who, convinced that research is the only "open sesame" to industrial progress, would lay bare the riches before they have got the wheelbarrows to carry them away. Research and the capacity to use it profitably must keep reasonably in step. That is, we suggest, one of the reasons why the research establishments connected with manufacturing firms prove so advantageous. The work done, unlike much that is performed without any specific object, is never for a moment in danger of neglect. Every atom of it is examined with its industrial significance in view and the greater part, by far, of the investigations are pursued for the purpose of discovering the solution of problems encountered in the ordinary course of commercial manufacture. Hence, whilst the potentialities of discoveries in the higher atmospheres of science may lie unexplored for years, the discoveries made by industry for industry are exploited at once. The D.S.I.R. could readily spend vast sums on research—there is no lack of workers ready to absorb the money—but if the work achieved were premature as far as the demands of industry were concerned, it would lie fallow for an indefinite period. That does not mean, as some assert, that science is in disrepute in this country. On the contrary, we are convinced that more interest than ever is being taken in it. "Industry," says the Report, "is proving itself increasingly anxious to take advantage of applied science. . . . The assistance of the Department is becoming more and more in demand by industry." But industry is a fly-wheel with an enormous amount of inertia. Changes in it can only come slowly, and the hurrying feet of Science must accommodate themselves

to its pace, or cease to be an effective guide. Science, indeed, must always be a little ahead, making the footprints or chipping the footholds for industry's ascent, but not so far ahead that it is lost in the mists on the mountain tops. Everyone recognises that "Research is to-day a necessity for the country whose industries are to survive the competition of energetic and scientifically informed rivals in the world market." It has to-day the sympathy of the bulk of industrialists, and that sympathy is more likely to be lost by the over-emphasis that is not unseldom placed upon it than to suffer by the moderation which is inspiring the work of the D.S.I.R. May we venture to suggest that the relationship between industry and science is not always understood by pronounced advocates of the latter? They desire, or seem to desire, to see it the predominant partner. Frankly, that is quite impossible and impracticable. The conditions under which industry must perforce be conducted are not those of the scientist. Industry does not want frequent changes, and, often enough, it cannot find the money for costly experiments. Its great desire is to carry on with methods and means which are bringing it a reasonable profit, even though it knows that they lack something of the best. But that does not mean that it is indifferent to science. It is only necessary to visit any factory which is reasonably up to date to see what a large number of inventions, now commonplace but once scientific, are in daily use. The constitution of metals is settled by scientific considerations, physical measurements are made by appliances which once were employed only in the laboratory, our machine tools are designed on scientific principles and use cutting alloys which were discovered in the laboratory. Welding, which is now taking such an important place in engineering, is being closely studied by research workers; there is no step in boiler design which is not the subject of scientific study; and every form of prime mover is continually subjected to investigation by experts. We need only mention the beautiful tests that are being made daily on the vibration of turbine discs, the erosion of blades, the development of materials and designs to resist high temperatures and high pressures, the employment of X-rays and other delicate tests for the discovery of flaws, and the industrial development of the phenomena associated with high vacua to see how close science is to industry. So we might go on indefinitely. Science is such a commonplace of the factory that we are apt to forget how much of it is used. Our industries could not exist at all without it; it is as essential to them as the air they breathe and as readily accepted as a matter of course. Even as we write steps are being taken to bring the work of our great national laboratory into closer touch with the engineering industry.

Whether or not Great Britain is less scientific than competing nations is a matter upon which differences of opinion may exist. Sometimes we suspect that the prevalent idea is the result of the greater parade which other countries make of their researches and has little substance in fact. We can, at least, say with confidence that as far as metallurgical research is concerned, the work of the National Physical Laboratory is unsurpassed by that of any laboratory in the world. In aeronautical research the results are sufficient evidence of the excellence of the investigations which are carried out in this country, and the same thing may be said with regard to the forms of ships. Our steam turbines owe a great deal to scientific studies, and are unexcelled by any the world over; whilst in electrical, chemical, and civil engineering we challenge comparison. One has only to glance through the Report which lies before us to see what a vast amount of research is going forward, ranging from low-temperature distillation of coal to the ionisation of the atmosphere. If, moreover, we remember that beside all this work, done under the public eye, much is being performed by private enterprise, we cannot but feel that the strictures upon the attitude of British industries to Science are inspired less by justice to what she is doing than by the very laudable desire to see even more done. The D.S.I.R. comes in for a good deal of criticism, but when its obligations to the public are considered, the policy which is outlined in the passage which we have quoted from the Report, conservative as it may appear to some, is well adapted to the conditions of British industries.

French Steel Organisation.

THE failure of the Steel Cartel as a factor of resistance against trade depression has induced French steel makers to look to some more effective organisation which may eventually place the international industry on a permanently stable basis. The Cartel suffers from the defect of a loosely applied scheme, which lays down principles without means of enforcing their observance. Every attempt to impose penalties for surplus production caused friction and discontent, and finally members took no account whatever of the Cartel restrictions when the world depression drove them to compete for trade in any way they pleased. As the negotiations to revive the Cartel with central sales organisation are making very slow progress, and there appears to be little hope of much being done under present international industrial conditions, the French steel makers have entered into a pact of their own, and they have all signed an undertaking to abide by the decision of three arbitrators who will fix the maximum steel production of each member based upon the individual outputs during 1929 and 1930. The total French production will be determined by the home consumption, so that there can be no surplus supplies of semi-manufactured steel, and prices and the distribution of orders will be left to a sales comptoir. In the same way, steel makers agree not to lay themselves out to produce more rolled iron and steel than now for a period of three years. All the existing sales comptoirs are to be maintained, and others will be created to cover all classes of iron and steel products, so that the whole industry will be organised in the way of limiting production to consumption and keeping prices at a definite level. The efficacy of this arrangement lies in the arbitrary powers of the governing triumvirate, which will have absolute control over the production.

In France this arrangement is possible because the normal home demand is sufficient to absorb most of the production, and it is believed that future economic developments at home and in the Colonies will increase that demand to the extent of taking all that steel makers can provide. This organisation of the steel trade is only practicable on the assumption that the French Government will carry out its policy of limiting the imports of iron and steel to what are necessary to make up for a deficiency of internal supplies. It will necessarily lessen the effects of an international trade slump upon French steel makers, since they will always get their prices for material which is produced more or less according to home requirements. There is an idea that this method of dealing with the situation will be adopted by some other producing countries, and that when manufacturers in each country are assured of their own market, it will be possible to build the Steel Cartel on those national agreements, and provide in the same way for a distribution of business from neutral markets at remunerative prices. With Germany, such an arrangement is possible on the condition that steel makers in that country get a bigger quota of trade than has so far been allotted to them, but Belgium and Luxemburg, which produce almost entirely for export, are less amenable to restrictions, and while the French national agreement to limit production strictly to the needs of consumers is being carried out, it will be more difficult to settle upon a satisfactory arrangement for the Steel Cartel. Much is likely to depend upon the attitude of British steel makers.

Modern Types of Propelling Machinery for Mercantile Marine Use.*

By STERRY B. FREEMAN, C.B.E., M. Eng., Member of Council.

No. I.

The relative numbers of steam and oil engine vessels given in Lloyd's Register at the end of September, 1931, reveal that for the higher powers the steam turbine is still unassailable, that the use of the internal combustion engine is still growing in popularity for the smaller ships, especially tanker tonnage, and that our position as the world's premier shipbuilder is being increasingly threatened.

In addition to recording what has been done in the actual selection of propelling machinery, an attempt has been made to discover, if possible, what might be in the shipowner's mind when inquiring for new tonnage, how he has been affected by the trend of building displayed in these records, and what his suggestions to his builders are. A number of builders have been asked to state the percentage of inquiries they have received in the past year for (1) plain reciprocating steam engines, (2) reciprocating steam and exhaust turbine engines, (3) turbine engines and gearing, and (4) oil engines. The results are appended, and are of interest as showing what the average shipowner evidently anticipated would be the best solution to his problem:—

	Steam reciprocating, per cent.	Reciprocating and turbines, per cent.	Turbine and gearing, per cent.	Oil-engines, per cent.
Ireland	55	5·5	12·0	27·5
West Coast ..	38	3·5	28·5	30·0
East Coast ..	66	2·0	1·0	31·0
Scotland	50	3·0	10·0	37·0

Steam Engines and Boilers.

Reciprocating Steam Engines.—The triple or quadruple-expansion engine of modern type works with superheated steam, and the tendency is to reduce weight by the use of higher speed, steel columns, hollow shafts, and single collar thrusts, and the engines are now generally partially balanced to reduce vibration of the ships. For the larger powers no radical departures from accepted practice have been noted in British design. Various attempts have beer made to improve upon the thoroughly tried and reliable reciprocating steam engine—for example, the engine developed by Messrs. Christiansen and Meyer. This is built as a double compound engine on the Woolfe principle, with semi-uniflow low-pressure cylinders, the steam to each pair of cylinders being controlled by one piston valve. Some forty sets have been built, all of small size, and the consumption is stated to be 1·135 lb. of coal per I.H.P.-hour.

The use of superheated steam has invited experiment with the valve gears, and although the Stephenson valve gear which has been in general use with reciprocating engines using saturated steam has also been used successfully with superheated steam, trials have latterly been made in marine work with valves actuated on the Mattern, Lentz, and Caprotti systems. In the case of the former, the engines of the Nederland Company's s.s. "Borneo" were converted to use steam at 500 lb. per square inch pressure and a total temperature of 750 deg. Fah. Whilst the economy was satisfactory, the difficulties of operation were evidently considerable, and no further conversions have been made. In the case of the Lentz valve gear, there are a number of engines employing this device, especially on the Continent, and a high degree of success is claimed for it. The Caprotti valve gear has been applied in conjunction with a Bauer-Wach turbine to the s.s. "City of Sydney" and "City of Barcelona" in the Ellerman fleet, but has not been generally adopted in this country. The main advantage of all these systems is that the steam inlet and the exhaust are separate, giving a sharp cut-off without throttling the exhaust when the gear is linked up. Marine engineers possibly feel that where prolonged and violent racing may occur and vigorous manœuvring is frequent, the piston valve and "D" slide valve are less likely to wear out or fail.

Turbines.—For the greater powers and in cases where the higher range of pressure is employed, the use of three or four turbines, each driving its own pinion on one common gear wheel, is now the usual practice. The dummy piston to reduce end thrust due to the unbalanced steam pressure, which disappeared from marine practice for some years, has now returned to use and is generally fitted, and for the greatest powers, double-flow balanced low-pressure turbines are adopted. Turbines are now practically always balanced dynamically.

Whereas temperatures in marine turbine work are already almost as high as in land practice, pressures, though steadily advancing, are a considerable distance behind. High pressures entail more serious gland, blade, and dummy leakages, and reduced efficiency due to higher density at the high-pressure end of the turbine and wetness at the low-pressure end, with, unless low blade speeds can be arranged, wear on the low-pressure blades by corrosion. These are handicaps which in a marine installation cannot be conveniently dealt with, as on land, by resuperheating, with its additional space, complication and weight. There is less incentive to attempt economies by the path of higher pressure since the difficulties of realising the theoretical gains increase with increased pressures in marine work more quickly than with increased temperatures. On the other hand, the metallurgical aspect of the problem shows that high pressures, which can be designed for, are less likely to cause trouble than the distortions and strains accompanying severe temperature gradients through the structure. Even in turbines working with superheat at a total temperature of only 600 deg. Fah. distortion of casings is not at all unknown. Incidentally, the cost of high temperature and pressure is greater in the case of the boiler and its equipment than in the case of the turbine.

Exhaust Turbines.—In modern types of reciprocating steam machinery a number of refinements have been adopted to reduce the running cost, all, however, at the expense of first cost. Sir Charles Parsons originally patented the idea of utilising the energy in the steam between the low-pressure cylinder—normally at, say, 5 lb. per square inch absolute pressure—and the condenser, by interposing a turbine which should reject the steam to the condenser at, say, 1½ lb. to 2 lb. per square inch and so increase the

* The fourth Thomas Lowe Gray Lecture. January 8th. (Abstract).

available power. Several ships were fitted with twin reciprocating engines exhausting to a turbine which drove a centre line of shafting and propeller. The combination of a reciprocating and turbine engine on one shaft, thus eliminating the relatively inefficient centre propeller, has been brought into the field of practical use by using the experience accumulated in the manufacture of gearing and elastic couplings and the recent knowledge of the phenomenon of vibration in rotary systems. For new ships of between 1000 and 6000 S.H.P. this system is practicable, but below these limits the arrangement is too complicated and above them a turbine alone is obviously preferable. In a coal-fired ship it is considered that the cost of the exhaust turbine installation can be written off in about five years. As, however, the majority of ships using coal-fired boilers and reciprocating engines were built before 1914, the margin of time in which the plant could be paid for and a satisfactory profit earned is not great, assuming that a vessel is obsolete in twenty-four years' time.

The system first and most in use is that developed by Bauer and Wach, which incorporates an oil-operated coupling constructed on the well-known Föttinger principle. The latter accommodates any shock, vibration, or uneven turning moment between the reciprocating and rotary motions. The turbine is cut out when the engine is running astern.

In the Metropolitan-Vickers exhaust turbine electric system the coupling comprises a generator and motor which permit of the necessary fluctuations between the turbine and reciprocating engine. In setting the exhaust turbine electrical system to work, steam is admitted to the turbine and at the same time the excitation circuits of the two electrical machines are established. Similarly, when reversing the propeller shaft, the excitation of the generator is reversed at the same time that the propeller shaft is reversed by operating the excitation switches from the exhaust steam inlet valve mechanism and reversing the gear mechanism respectively. The turbine is reversed with the reciprocating engine and then rotates in vacuum. The Brown, Boveri system of exhaust steam turbine has a ring spring coupling mounted directly on the main propelling shaft. The turbine is not uncoupled when manœuvring, but a manœuvring turbine is provided which decelerates or accelerates the exhaust steam turbine when manœuvring.

The use of exhaust turbines coupled to reciprocating engines using high superheat and involving liberal lubrication, and with high-pressure boilers, is undesirable on account of the danger of passing cylinder oil through the system to the tube surfaces. Altogether there are about 200 vessels which are fitted with a combination of steam turbines and reciprocating engines. The economy effected appears to be about the same in each system. Using saturated steam and with a vacuum of 28in. of mercury, an increase of power of, say, 23 per cent. may be expected. With superheated steam the gain might be 21 per cent., or a corresponding economy of fuel at a constant power.

Turbo-electric Drive.—There are at present in the mercantile marine some 73 ships of about 1,135,000 S.H.P. fitted with turbo-electric and 129 ships of about 10,000 S.H.P. fitted with Diesel-electric propelling machinery. The greater number of these are owned in the U.S.A. It is of interest to hear that the electric transmission plant has been removed from the "New Mexico" in favour of mechanical gearing, and that electric transmission has been finally rejected for the new French Transatlantic liner.

The advantages claimed for electric transmission in passenger ships are freedom from noise and vibration, greater economy when steaming at less than the designed full speed, the provision of 100 per cent. of the ahead power for propelling the ship astern and the elimination of the astern turbine, greater economy consequent upon the higher turbine speeds possible, additional immunity from the possibility of damage by shock reaching the turbine from the propeller—due to the fact that the connection between the turbines and the electrical plant is through the air gaps of the motors and generators—and the possibility of using shorter steam pipes and shafting.

The drawbacks are the reduced overall efficiency due to electrical losses, the amount of which is greater than in the case of mechanical gearing, the inferior robustness of the higher-speed turbine, the greater first cost involved, the heavier weight of machinery to be carried, and the greater floor space occupied.

Much is made of the fact that full power is available for going astern, but it should be remembered that the power provided in the ordinary geared turbine is found adequate for the purpose intended and that full torque is always available. The major consideration is that now so many of the large passenger ships are designed to spend part of their time in pleasure cruises at lower speed and power than their maximum, and that the speed of mail boats is varied to suit the terms and conditions of their contracts, the commercial efficiency of the electric drive may be higher than that of the geared turbine. The cost of repairs is normally very low and a great amount of experimental work has contributed to this result.

Gearing.—Confidence in mechanical gearing has been largely restored by the absence of frequent failure. At the same time it is known that several modern ships have been returned to their builders after a short experience at sea to have their gear wheels dealt with, and there have lately been one or two cases of serious damage to the gear teeth in modern vessels of large power. An ingenious method of renovation has been employed in several instances by re-cutting the teeth of the wheels on the "enveloping tooth" system. This device makes it unnecessary to renew the shround of the wheel and yet leaves the tooth sufficiently strong to transmit the original power.

Boilers.—In using cylindrical boilers pressure is virtually restricted to an upper limit of 300 lb. per square inch, owing to the limitations inherent in the flat surfaces of the combustion chamber and the practical limit of thickness possible in a circular furnace. If a dry-back boiler were used to avoid the first of these objections, its efficiency would be lowered unless the space occupied were largely increased. If the furnace diameter were reduced to lessen its thickness it would not be possible to burn coal economically in the restricted space.

There is no doubt that steam pressures higher than can be used with cylindrical boilers are necessary if marine machinery is to be economical, and only by using water-tube boilers can this increase of boiler pressure be gained. There are, nevertheless, still many owners who consider that it is safer to retain the cylindrical boilers.

The water-tube boiler can be divided into two generic types: the moderately inclined tube boiler with definite ring circulation, of which the Babcock is the best-known example; and the tri-drum boiler, of which the Yarrow and Thornycroft are the established representatives. A new two-drum curved tube design—the Johnson—now has to be added as a simplified development of the tri-drum. The "King George V." still holds the record for the highest steam pressure in the world, excluding the "Uckermark" with her one high-pressure boiler operating in conjunction with lower-pressure main boilers. Overall efficiencies of some 80 per cent. have been regularly recorded on the "King George V." with hand-fired coal under closed stokehold conditions. The overall boiler efficiency of the oil-fired "Statendam" over a double Atlantic crossing was stated to be 87 per cent., and on the "Monarch of Bermuda" 84 per cent.

The success of the water-tube boiler under ordinary mercantile marine conditions was made possible largely by two recent developments which have dispelled the fear of salt water finding its way into the boilers. In the first place, Johnson in 1929 described his arrangement of one or more cylindrical boilers evaporating steam for the auxiliary services in the ship, the steam when condensed being fed back into the water-tube boiler system as make-up feed. Secondly, cupro-nickel or aluminium-brass condenser tubes can be relied upon not to leak. The provision of a steady supply of distilled water to replenish the boilers and the discovery of reliable condenser tubes has thus changed the outlook of most marine engineers on the boiler problem.

The latest marine type is the Johnson boiler. It is a water-tube unit with a minimum of brickwork in the combustion chamber, arranged for oil or pulverised-fuel firing, which takes place in a complete nest of water tubes. The boiler has a large top and smaller bottom-drum connected by tiers of curved water tubes. It is claimed that the virtual elimination of brickwork means a reduction in weight and wear and tear with higher output and rapid circulation in the tubes. As the radiant-heat transmission surfaces are increased in this boiler, the rating can be increased to compensate for the loss due to the increased saturation temperature of the high-pressure steam, which diminishes the mean temperature difference between the steam and the combustion gases. It is claimed that the Johnson boiler for the same weight and air-heater capacity will give double the output of the ordinary three-drum marine type water-tube boiler, while answering to varying demands and heating up rapidly.

That very high steam pressures can be used in modern marine machinery is demonstrated by the employment of a Benson boiler in the Hamburg-American liner "Uckermark." In this case a cylindrical boiler was removed and a Benson boiler of a generating capacity of 20 tons per hour, was arranged for burning fuel oil. The working pressure is 220 atmospheres (3120 lb.) per square inch, and the steam temperature 750 deg. Fah. As the water travels through the tubes in series it rises in temperature to 707 deg. Fah. The approach to the critical state is indicated by a great expansion of the volume of the water, beginning at about 660 deg. Fah. and finally resulting in the formation of steam at the same volume as the original water. The steam passes from the boiler through an automatically controlled reducing valve, which lowers the pressure to 1200 lb. per square inch. It then passes through a superheater to a two-stage high-pressure turbine incorporating an astern turbine in the same casing where the conditions are approximately 850 lb. per square inch pressure and 840 deg. Fah. temperature. The speed of 6000 r.p.m. is reduced by double-reduction gearing to 100 r.p.m. at the propeller shaft and the steam passes from these turbines to the old high-pressure turbine at 120 lb. per square inch.

The evaporation of water per square foot of heating surface is reckoned at 15·8 lb. and the steam consumption with the high-pressure turbines outlined above is understood to be 6·8 lb. per S.H.P.-hour. The critical points in such a boiler plant are the functioning of the feed pump, and the control of the feed supply and the fires, which are handled by means of a special system of electrical signals.

Air-heating.—In the later air-heating systems thin corrugated plates absorb heat from the uptake gases and deliver it to the incoming air. The temperature at which air is delivered to the furnace with the older tubular heater is about 225 deg. Fah. With a similar lay-out, but using a revolving heater of corrugated plates, the temperature is raised to 350 deg. Fah. Some difficulties have been experienced with the plate types of heater on account of a heavy deposit of ash or clinker being carried into the interstices of the plates and choking them, and at first there was difficulty in finding a suitable fire-bar to withstand the higher temperature. A fire-bar designed to permit the flow of air through passages set at close intervals over the face of the bar has been found satisfactory. Although considerations of weight and space in a marine installation tend to keep the size of the air-heater down, it is noticeable that in a water-tube boiler-room lay-out the air-heater may reach a height of 40ft. in the effort to take the desired quantity of heat from the funnel gases before release.

Mechanised Firing.—Pulverised fuel has recently been tried at sea in cylindrical boilers, and mechanical stokers have been used to burn coal in water-tube boilers. In spite of much hard work and enterprise on the part of those producing and using the plant, and the sympathetic attitude of shipping circles and the Press, there has not been much development in the past year or so, although Messrs. Clarke, Chapman have recorded the fitting of several ships with their plant recently. The small furnace of the cylindrical boiler is not suitable for mechanical grates, and for that reason pulverised coal has been tried under various systems with this type of boiler. The large-furnace water-tube boiler allows for the variation in mill performance due to coal fluctuations in a manner which the Scotch boiler, with its confined flues and furnaces, cannot hope to do. The problems to be solved are the pulverisation to a sufficient and regular degree of fineness—and, incidentally, an agreement is needed as to the sampling and measurement of the product—the even and close control of the distribution to each furnace, the reduction of the wear and tear on the plant, and the avoidance of emission of unburnt particles. There are a number of burners on the market giving the necessary short flame with efficient combustion, and this is not the stumbling block.

The use of mechanical grates has been associated in marine practice with water-tube boilers, and Johnson in the Canadian Pacific Railway Company's and Muller in the Koninklijke Paketvaart Maatschappij ships have shown what can be done with this plant. The C.P.R. ships of the "Beaver" class, using Erith-Roe or Taylor stokers, show a boiler efficiency of 84 per cent. Using the Underfeed stoker Dr. Muller reports an efficiency of 80 per cent., but adds that it has been found more economical to install oil engines in their newer ships.

The first application of stoker firing to a cross-Channel steamer is in the "Duke of Lancaster" for the London, Midland and Scottish Heysham-Belfast service.

Superheated Steam—The use of superheated steam at sea has become much more general in the past few years and is being adopted for practically all the new turbine-driven ships and many of the ships with reciprocating engines. In the reciprocating engines a superheat of 160 deg. Fah. is common, and in the later turbines the degree of superheat is stabilised at about 275 deg. Fah., so that with a pressure of 400 lb. per square inch the total temperature is 725 deg. Fah. Although, in land practice, the largest and most economical plants were long ago equipped with superheaters, marine engineers have, until lately, been obsessed with the idea that the use of superheated steam would involve difficulties in operation and renewal costs which, together with the increased first cost, would nullify any saving of fuel.

In cylindrical boilers the smoke-tube type of superheater has been developed so as to gain a higher degree of superheat by the use of a nest of steam tubes fitted in the combustion chambers and connected by an outward and inward flow-pipe through the smoke-tubes to the steam-headers. In view of the likelihood, if coal were used, of this nest being filled up with ashes, &c., it has only been employed with oil-fired boilers. If the superheater is in the smoke-box a temperature of about 90 deg. Fah. can be obtained, if in the tubes of about 180 deg. Fah., and if in the combustion chamber of about 300 deg. Fah. In water-tube boilers the superheaters are nowadays placed within the setting of the boiler, so that the hot gases are utlised both for generating saturated steam and subsequently superheating it.

(To be continued.)

IN a paper read before the Institution of Automobile Engineers, Mr. E. C. Ottaway discussed pistons and piston rings of petrol engines in connection with oil consumption. He described many different styles of design and explained their merits.

56,800 B.H.P. OIL ENGINE MACHINERY FOR THE GERMAN BATTLESHIP "DEUTSCHLAND"

(For description see opposite page).

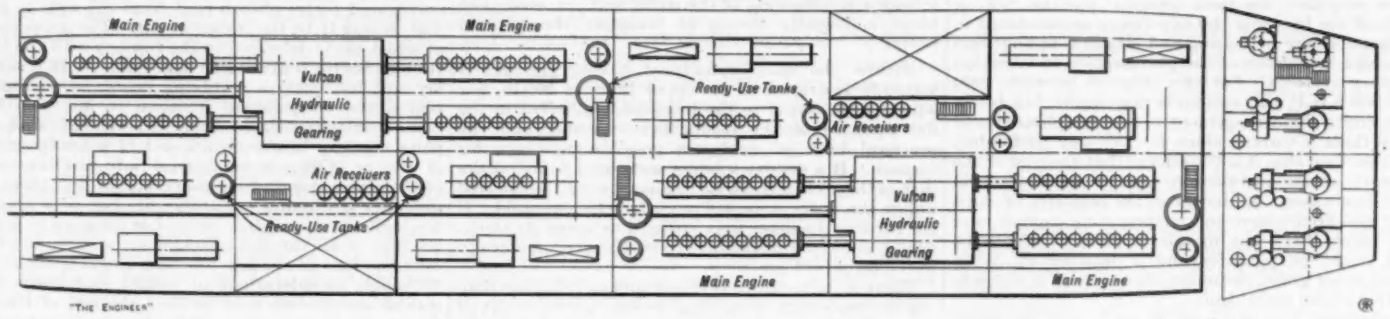


FIG. 16—GENERAL LAY-OUT OF ENGINES AND GEARING

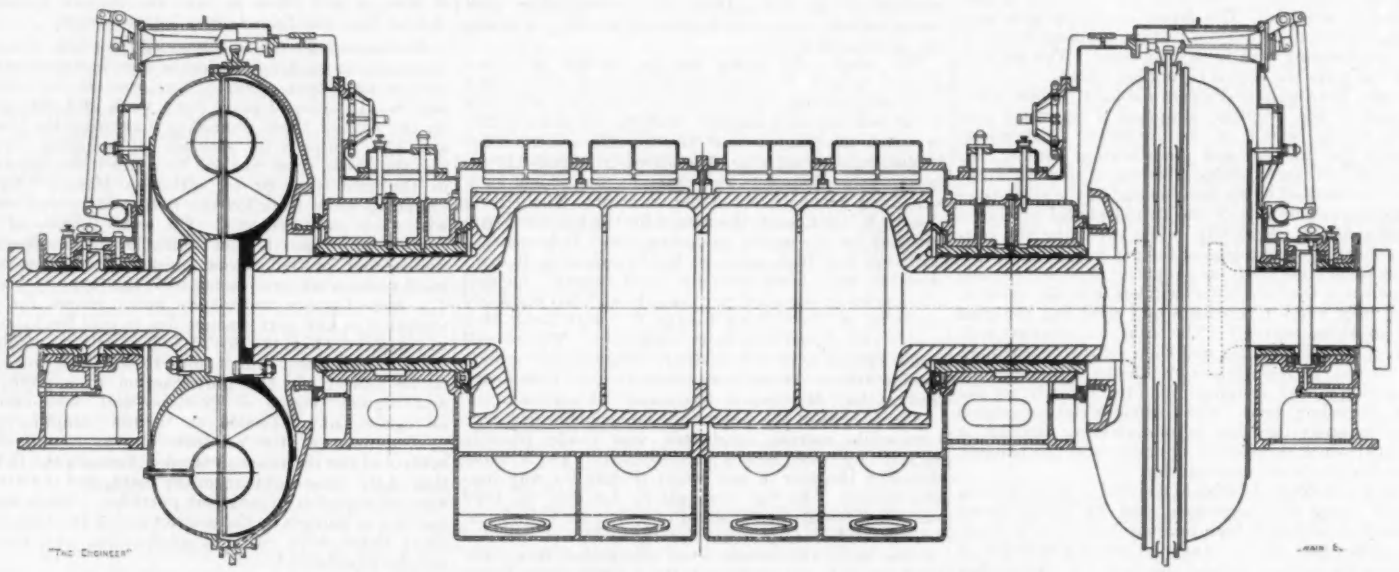


FIG. 17—SECTION THROUGH PINION AND HYDRAULIC COUPLINGS

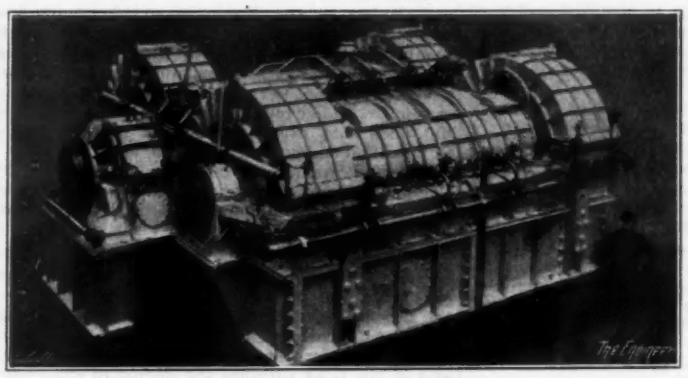


FIG. 18—COMPLETE GEAR-BOX UNIT

FIG. 19—VANE WHEELS FOR HYDRAULIC COUPLINGS

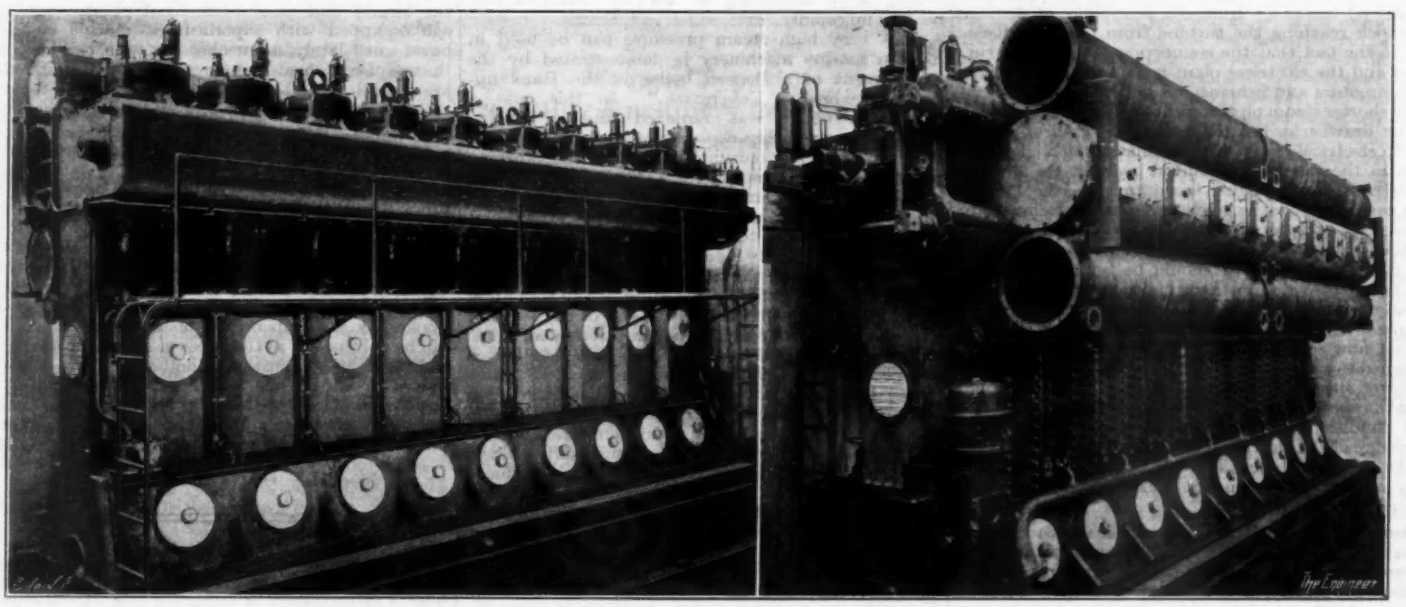
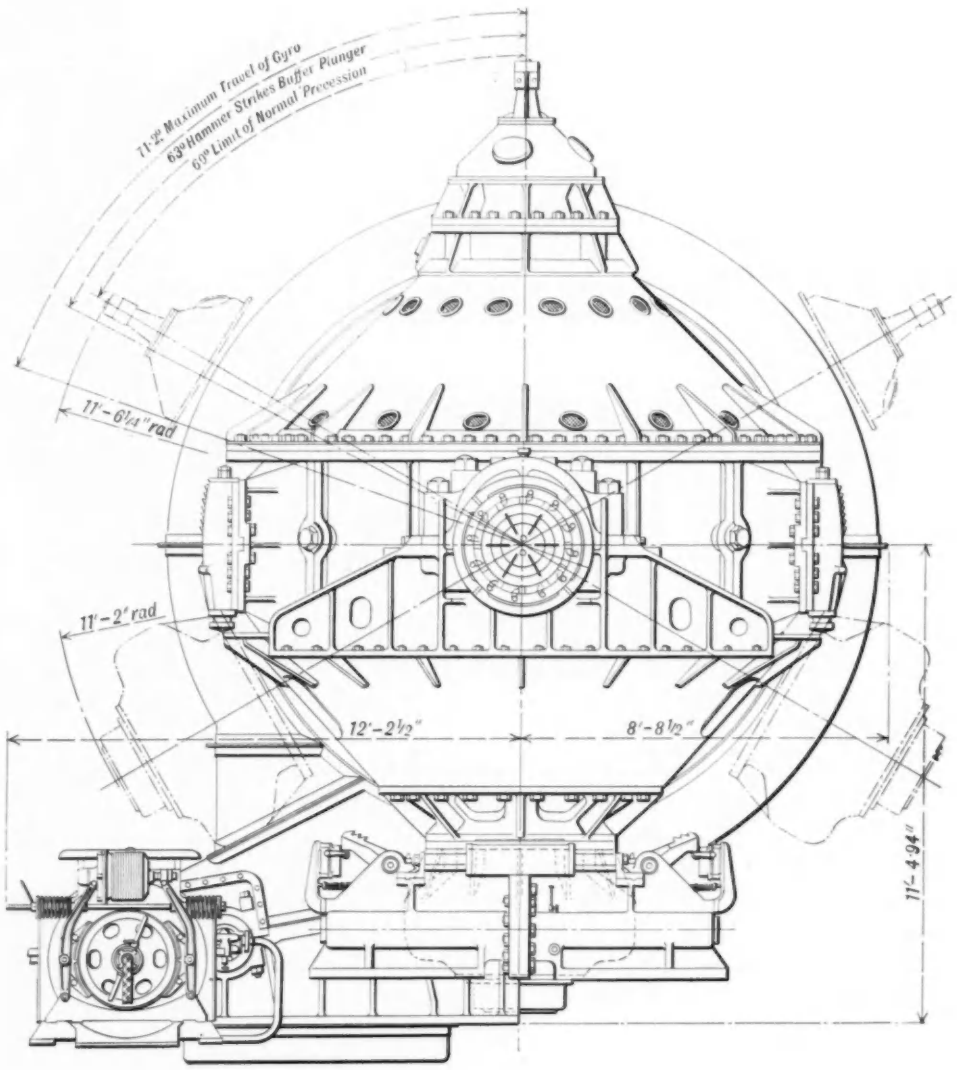
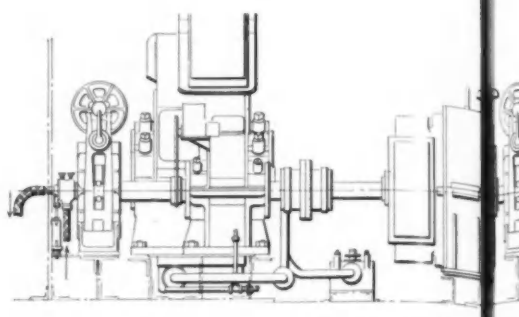


FIG. 20—FRONT AND BACK VIEWS OF 7100 B.H.P. PROPELLING ENGINES

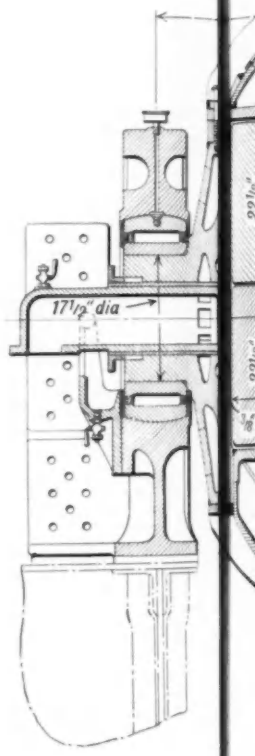
GYROSCOPIC STABILISING EQUIPMENT FOR HE

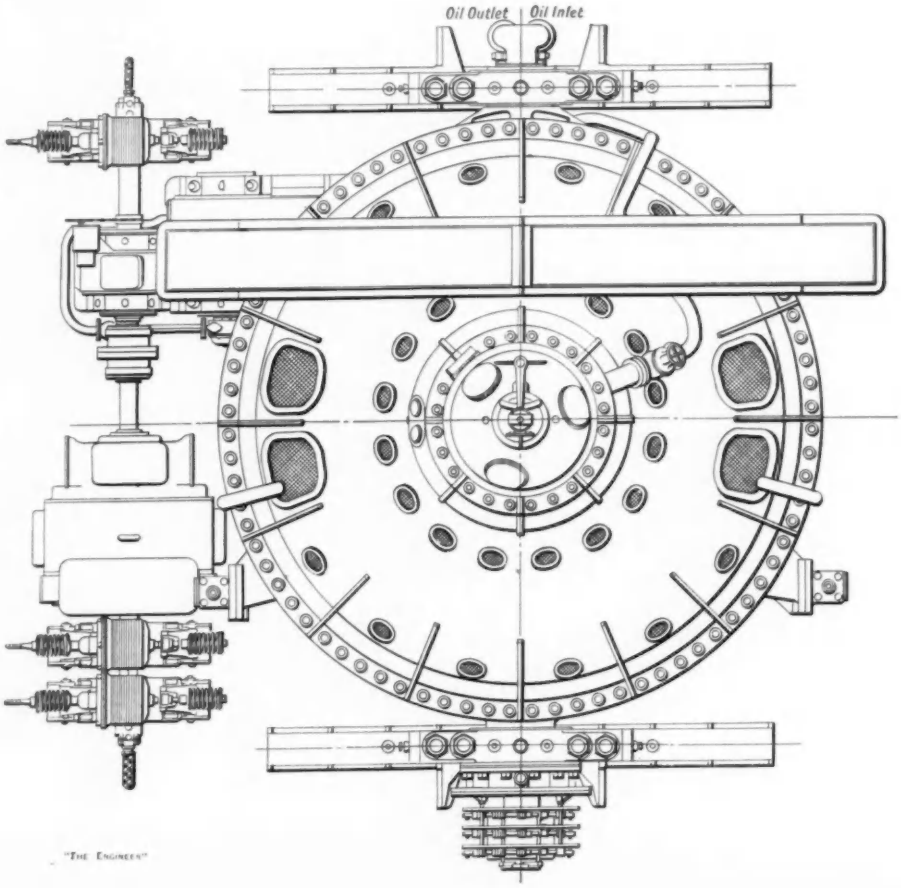
SPERRY GYROSCOPE CO., LTD., LONDON, ENGINEERS; VICKERS-ARMSTRONG LT

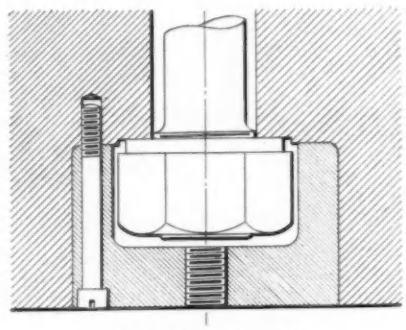




- ELEVATION OF PRECESSING GE







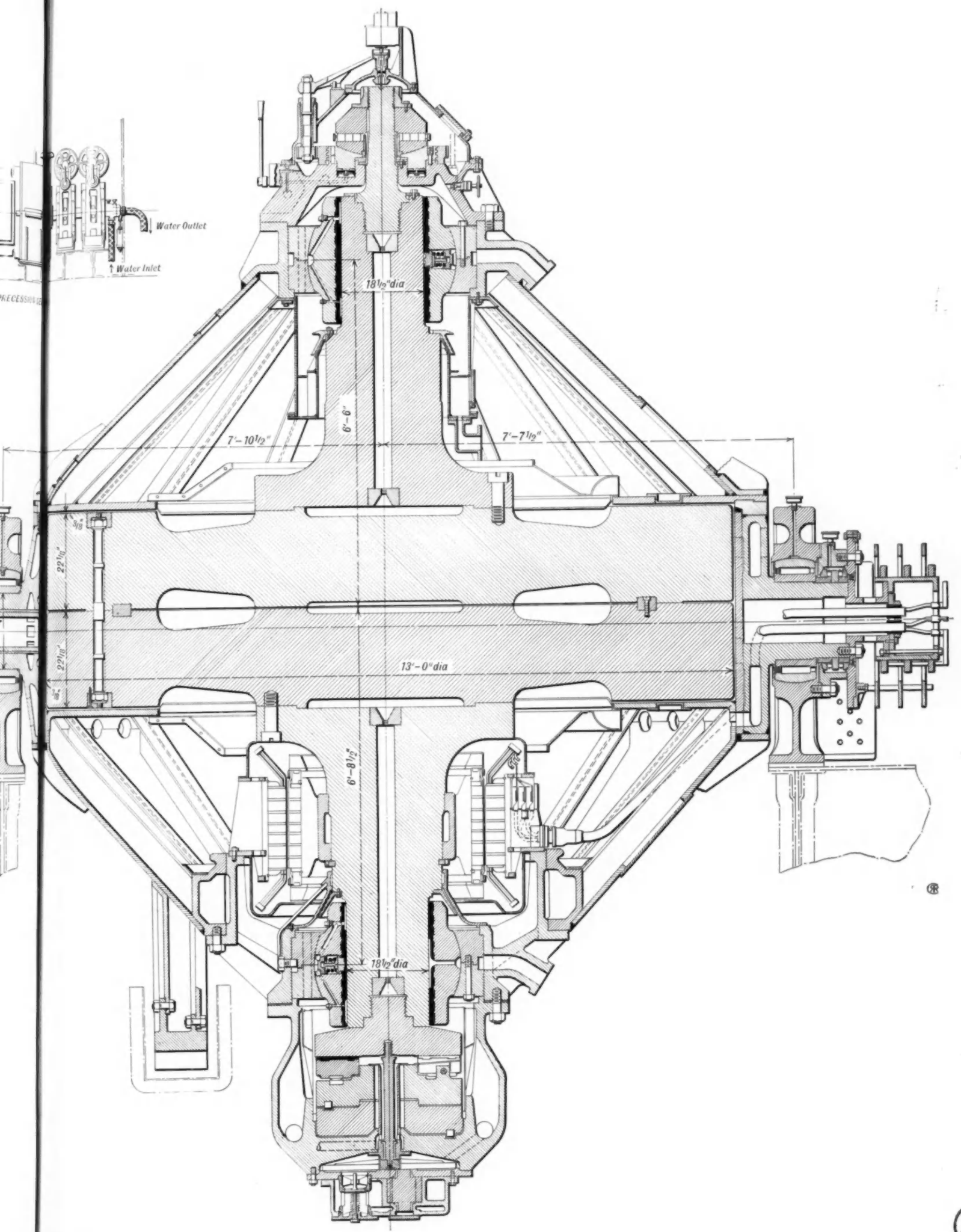
CAP FOR FLYWHEEL BOLTS.

"THE ENGINEER"

UNIV. OF ILL.

FOR HE LLOYD SABAUDO LINER CONTE DI SAVOIA

ARMSTRONG LTD., AND METROPOLITAN-VICKERS ELECTRICAL CO., LTD., CONSTRUCTORS



UNIV. OF MICH.

Shipbuilding and Marine Engineering in 1931.

No. III. (*conclusion*).*

Marine Oil Engine Progress.

THE year just ended was more noteworthy for the motor ships completed than it was for the new engines which were designed and tested. The comparative results obtained at sea with various types of oil engine plant were particularly valuable and will doubtless find a reflection in future marine oil engine designs.

On the whole 1931 saw a consolidation of the leading position which has been held for some years by the four-stroke single-acting engine, which, with the adoption of continuous supercharge or pressure induction, combined with the recovery of the heat from the exhaust gases in improved silencer boilers, showed a greatly improved performance. Noteworthy in this respect were the Werkspoor engines of the new Anglo-Saxon oil tankers, which were referred to in our article of January 1st. We illustrate in Fig. 23 two of these engines erected in the Werkspoor factory. They form the propelling machinery for one of the seventeen 11,500-ton oil tankers built in this country and on the Continent for the Anglo-Saxon Petroleum Company, Ltd. The engines illustrated are generally similar in type to those which were supplied by R. and W. Hawthorn, Leslie and Co., Ltd., and the North-Eastern Marine Engineering Company, Ltd. They have a total rated output of 5200 I.H.P., and we are informed that the saving of fuel in actual service, which is made possible by the exhaust gas boiler, is in the region of 3 tons per day. New designs of such boilers were introduced in 1931. Other noteworthy supercharged oil engine installations were those of the quadruple-screw trunk-piston engined liners "Reina del Pacifico" and the new North Sea motor liner "Venus." In the one case Büchi exhaust gas turbines are employed in continuous service, while in the "Venus" the Burmeister and Wain chain-driven blowers are operated directly from the engine crank shaft. With this arrangement, combined with a special valve setting, the makers claim that there is no increase in the back pressure of the exhaust gases, the horse-power thereby saved compensating for that required for driving the blower. Another outstanding type of engine for which operating results were first obtained in 1931 was the four-stroke single-acting supercharged oil engine for the Holt cargo liner "Polyphemus" and sister ships, engines of this type being constructed by both Scott's Shipbuilding and Engineering Company, Ltd., and the North-Eastern Marine Engineering Company, Ltd. In the Marine Oil Engine Trials Committee's report of November last the performance figures of this engine were fully dealt with. The report appeared in an abridged form in our issue of November 27th. Fig. 21 illustrates the port engine of the "Polyphemus," a type of engine which is distinguished by its all-British design.

During the year, several sets of oil engines of the Sulzer two-stroke single-acting type were built on the Tyne and the Clyde and gave good results at sea. The Doxford opposed-piston engine was fitted into several oil tankers which were commissioned in 1931, and the fire on the "Bermuda" deprived that firm of further results from a most interesting and successful quadruple-screw arrangement of Doxford motors. At Belfast and Glasgow several installations of Harland-B. and W. type engines were completed, the largest being the 20,000 S.H.P. engines for the White Star liner "Georgic," which are of the four-cycle double-acting type. Progress has to be recorded with engines working on the two-stroke double-acting principle, and in our issue of May 1st we described and illustrated the new 7500 B.H.P. Sulzer engine which embodies new and interesting features in design. The operating results of this type of engine will be awaited with interest. Good results were obtained with the Burmeister and Wain double-acting airless-injection engine in the Danish motor ship "Amerika," her sister ship "Europa," and the Holt liner "Stentor," while work was continued by Burmeister and Wain, Ltd., on a large 22,000 B.H.P. stationary oil engine of this type which will be installed in the Copenhagen electricity works. During the year the same builders developed a new single-acting two-stroke oil engine of the straight-through scavenge type, both for propelling and auxiliary services, and also for use in rail cars, a development which has been taken up with success by Harland and Wolff at Belfast.

A new engine of 1931 which was tested towards the end of the year was the 4000 B.H.P. Vickers-M.A.N. airless injection two-stroke double-acting motor, which we illustrate in Fig. 22. It is a six-cylinder unit with a bore of 600 mm., or about 25⅝in., the stroke being 900 mm., or about 35 7/16in. The full power is developed at about 130 r.p.m. and the fuel consumption obtained on test show figures of 0·35 for three-quarter load up to 0·36 for slightly over full load, the fuel consumptions at half and quarter loads being 0·356 and 0·378 respectively.

Auxiliary Oil Engines.

A feature of the development which took place in 1931 was the continued increase in operating speed. An interesting engine of the high-speed type was the Mirrlees-Ricardo sleeve-valve motor, which is constructed in six and eight-cylinder units with designed outputs of 120 and 400 B.H.P. at speeds of 1200 and 900 r.p.m. respectively. The weights of these engines with cast iron frames are about 35 lb. to 45 lb. per B.H.P., but by utilising aluminium framing these weights can be reduced a further 10 lb. without any decrease in the wearing surfaces. A full description of one of these engines was given in our Olympia Supplement of September 11th. Another high-speed engine of note was the steel-framed Davey, Paxman engine, which type of motor is advantageous as regards weight for both main propulsion and auxiliary services. Other new oil engines of the year included the National Gas Engine Company's 150 B.H.P. six-cylinder engine, described in our issue of September 18th. Considerable attention was devoted to the production of high-speed airless-injection engines, most of which have already been fully described in our reports of the various exhibitions.

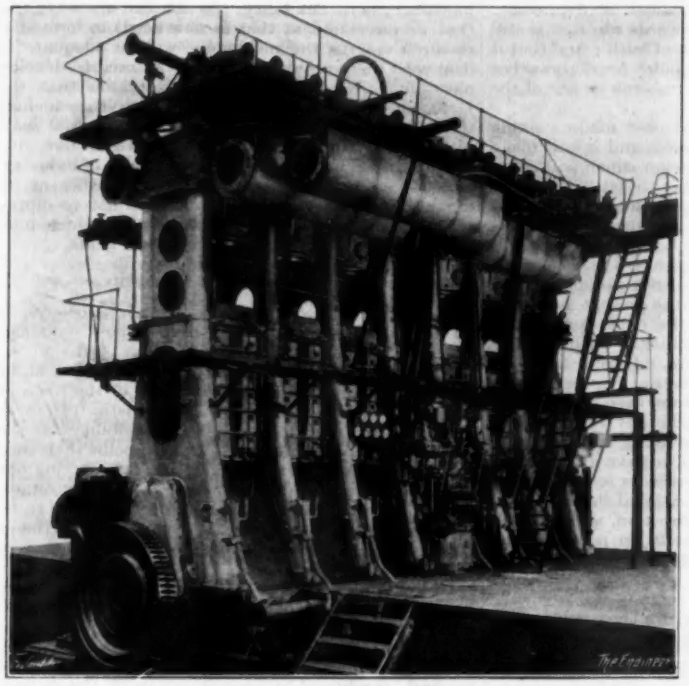


FIG. 21—PORT ENGINE OF THE "POLYPHEMUS"

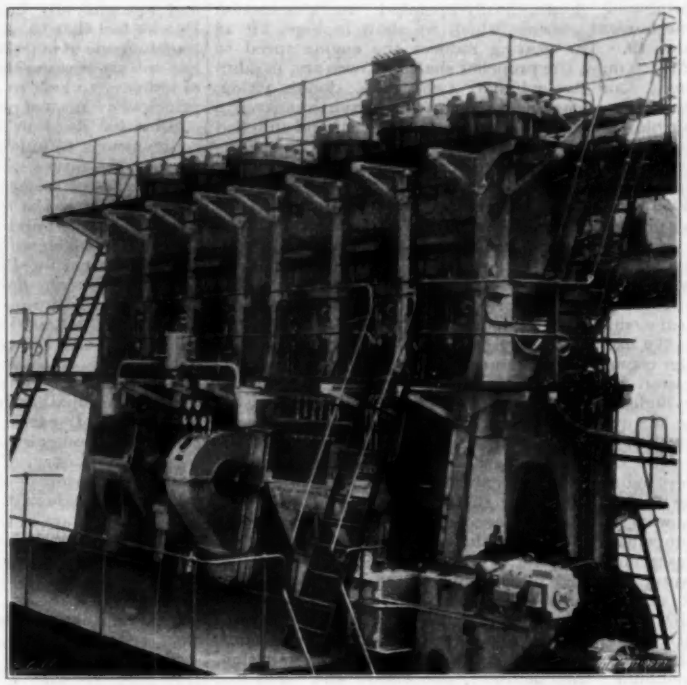


FIG. 22—VICKERS DOUBLE-ACTING TWO-STROKE ENGINE

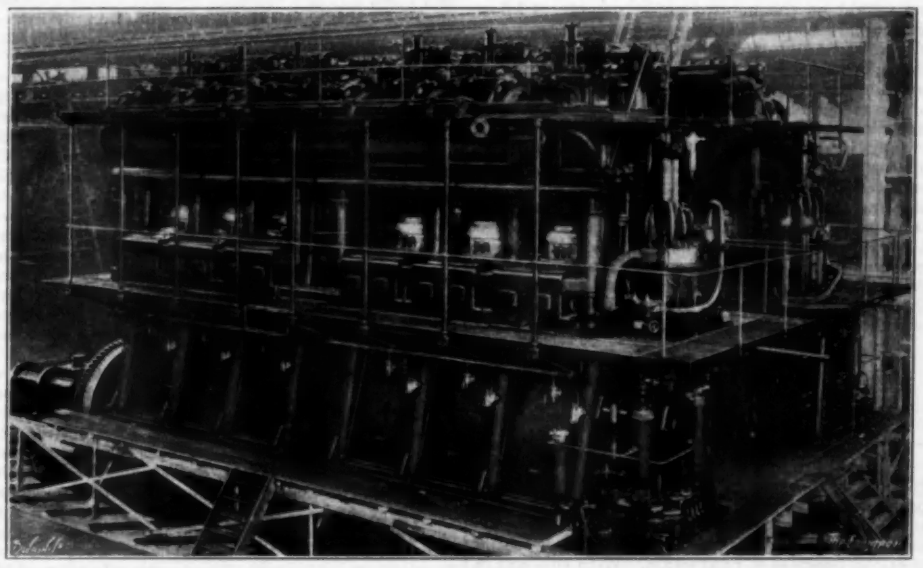


FIG. 23—WERKSPOOR SUPERCHARGED ENGINES FOR ANGLO-SAXON TANKERS

The Machinery of the German Battleship "Deutschland."

Any account of marine oil engine progress in the year just ended would be incomplete without some reference to the arrangement of twin-screw oil-engine machinery for the new German pocket battleship "Deutschland," which we illustrate on page 76.

* No. II. appeared January 8th.

The design of the engines was entrusted to the Maschinenfabrik Augsburg Nürnburg, and they were constructed at that firm's Augsburg works, while the hydraulic gearing was designed and built at the Vulcan-Werk Hamburg of the Deutsche Schiff und Maschinenbau Aktiengesellschaft. We are indebted to the above-mentioned firms for the illustrations accompanying this article. As Fig. 16 shows, the main engines—see Fig. 20—comprise eight sets of nine-cylinder, double-acting, two-stroke, compressorless engines, each of which has a designed output of 7100 S.H.P. at 450 r.p.m., making a total of 56,800 S.H.P. at the couplings, or 54,000 S.H.P. at the propeller shafts. As our drawing indicates, the engines are coupled in two groups of four to the combined hydraulically-operated single-reduction mechanical gearing which we show in Figs. 17 18 and 19. The gearing reduces the engine speed to 250 r.p.m. at the propeller shafts. There are, in addition, four five-cylinder, two-stroke, double-acting, auxiliary oil engines, which serve to drive the scavenge air blowers. The blowers were designed and supplied by the Frankfurter Maschinenbau A.G., of Frankfort-on-Main, and are driven through gearing, the engine speed being 425 r.p.m. and that of the blowers 3050 r.p.m. All the engines operate with a scavenge air pressure of about 5 lb. per square inch.

Both the main and the auxiliary engines have a cylinder bore of 420 mm., or a little over 16½in., with a stroke of 580 mm., or about 22⅞in. The engine framing is electrically welded and it is specially stiffened at all the important points. A novel feature is the use of a rotary exhaust valve, which shuts off the connection to the exhaust pipe immediately the piston begins to cover the scavenge ports in the cylinder, with the result that the compression pressure in the cylinders at the beginning of the compression stroke is about the same as that of the scavenge air.

The design employed has enabled an engine to be produced with the extremely low weight of 8 kilos., or about 17·6 lb. per B.H.P. This weight does not, however, take into account the Vulcan drive, the propellers and their shafting, or the starting air reservoirs, nor the lubricating oil and the cooling water included in the engines when running, but it does include we understand, an allowance for the auxiliary engine and the scavenge air blower. If all the auxiliary machinery be taken into account, then the total weight of the whole installation, including the gearing, propellers and shafting, together with the piping, gratings and floor plating, &c., works out at about 22 kilos. per B.H.P., or 48·5 lb. On good authority we are given to understand that in service the weight will be about 51 lb. per B.H.P., which is a noteworthy figure for oil-engine practice. Our illustration of the gearing clearly shows the arrangement of pinions and gear wheels, with the oil-operated hydraulic couplings of the standard Vulcan type. As the auxiliary machinery of the "Deutschland" is largely electrically operated, a large installation of oil engine-driven generator sets had to be provided, there being no less than eight 250 kW A.E.G. generators coupled direct to fast-running 1000 r.p.m., six-cylinder airless injection engines of 375 to 400 B.H.P. each, manufactured by the Linck-Hoffmann-Busch Werke, of Breslau. These engines, it is interesting to note, have about the same weight as the main engines, namely, 8 kilos., or about 17·6 lb. per B.H.P.

The trial results of the main engines, which were tested at the Augsburg factory of the M.A.N. Company, showed a minimum fuel consumption at 400 r.p.m. corresponding to 153·5 grammes per B.H.P.-hour,or less than 0·34 lb. This represents a thermal efficiency based on fuel oil of a heating valu of 10,000 calories per kilogramme, of 41·2 per cent., which is reduced, however, to 38·6 per cent. under full power and speed conditions. Including the scavenge blower power, the total oil consumption works out at 176 grammes, or 0·385 lb. per B.H.P.-hour. The German naval authorities and the builders are to be congratulated on the excellent results obtained with the engines, and their performance at sea will be watched with more than usual interest.

Department of Scientific and Industrial Research.*

IT has been clear to each successive Advisory Council from the outset that the main endeavour must be to encourage industry to look on scientific research, not as a last resource, but as an essential part of the business of production. With this end in view, they have made it their constant aim to define and emphasise the part which science properly applied can play in the country's industrial life, and to prove that the researches already carried out have provided technical assistance in the improvement of productive efficiency previously unobtainable. We believe that our predecessors' efforts have contributed substantially to increase the competitive power of British industry. Industry in general is proving itself increasingly anxious to take advantage of applied science. We have clear evidence that the assistance of the Department is becoming more and more in demand by industry, and we feel no doubt that it is now generally realised that the initial advantages which this country secured through her island position, her natural resources, and the technical skill of her workers are no longer sufficient in themselves to enable our manufacturers to withstand the organised and scientific rivalry of competing countries.

But while we are naturally encouraged by the more co-operative attitude displayed by industry towards scientific research, we are convinced that something further is called for by present-day needs. We gladly admit that, as the scientist and the industrialist by their increasing association come to appreciate the measure of their common task, so science is becoming more and more recognised as a profitable investment, and a useful ally in fighting industrial depression. But we feel that the attitude towards research is still too often one of hope rather than of faith; and that it has not yet become a matter of habit for all branches of industry to look to scientific research as one of the principal avenues of progress.

Scientific research has in the past made striking contributions to industrial progress and it will make them in the future. But the nation which will enjoy the benefits of science in the day-to-day progress of its industries is the nation which habitually applies scientific method and scientific knowledge; and it is that nation which will be able to seize the advantages of the more spectacular achievements of science in the industrial sphere. Scientific research cannot provide a ready-made solution of any of the present industrial difficulties; but it does point the road along which persevering effort may enable industry to find a way out of some of those difficulties. During the past twelve months of growing industrial depression our main preoccupation has therefore been to consider whether the Department can take any further steps than it has done already to ensure the application of science by industry. To this end we have made a comprehensive review of the arrangements for promoting contact with industry. We are satisfied that the steps already taken are in the right direction, and that the organisation which has been built up possesses the flexibility necessary to adapt itself to new needs as they may arise.

I.—The Natural Growth of the Department's Organisation: Its Flexibility.

Scientific and industrial research is no novelty in this country. The steam engine, technical developments in the manufacture of iron and steel and their alloys, the mechanisation of the operations of spinning and weaving in textile manufacture, the use of electricity as a source of light and power and for communications, all largely originated in this country. The scientific investigations from which such momentous results emerged were the individual work of men of genius. But times have changed and individual work must be supplemented by organised effort in industrial research no less than in other forms of industrial development.

With the creation of the Committee of the Privy Council for Scientific and Industrial Research in 1915, the State, for the first time in the national history, began an organised attempt to help industry generally through the technical services of science. In less than two years the new machine developed into a department of State which quite naturally became responsible for financing the work of the National Physical Laboratory.

The most adventurous step taken by our predecessors was the initiation of a scheme for the formation of co-operative research associations set up and controlled by the industries themselves with initial help of a financial nature by the Department. The experiment then embarked upon has no exact counterpart in any other country of the world. It paid due regard to the attitude of British industry towards State assistance and control, and consequently forms an essential feature in the flexibility of the State organisation for the encouragement of industrial research. Co-operative research associations have been formed in over twenty industries in the country and cover fairly well the industrial field suited to their operations.

But the scheme is not suited to the needs of all industries. In some industries, for example, engineering and the heavy chemical industry, the units of organisation are of sufficient size to conduct research in their own interests on a very extensive scale. There were other large sections of industry, presenting ample scope for the application of scientific knowledge, in which there was no compelling evidence of a community of interest which would induce firms engaged in the industry to co-operate for the necessary research. The interest to be served was primarily that of the user which was the community as a whole. In such cases research, if it was not to be left to chance, required organisation on a national basis, and the financial support of industry was sought, not for an organisation, but for specific pieces of research. It is interesting to observe that the research work which the Department itself developed in the national interest was, in general, that required to deal with the primary needs of man, his food, fuel, building, his use of timber, and the protection of his drinking water from pollution.

The variety of organisation did not end here. As need arose the Department established temporary organisations to deal with particular problems requiring the application of science to industrial requirements. As outstanding examples of this type of organisation may be mentioned the Bridge Stress Research Committee, the Steel Structures Research Committee, and the Locomotive Experimental Station Enquiry Committee.

We have thought it well to sketch thus briefly the wide diversity of the organisation which the Department of Scientific and Industrial Research has introduced into its machinery for promoting the application of scientific method and scientific knowledge in industry, because in our judgment this diversity of organisation reflects accurately a wide diversity in the problem to which the Department has addressed itself. The essential characteristic of the Department's machinery is its flexibility. So satisfied are we of this that we are confident that as new needs in industrial research emerge the machinery will be adequate to deal with them provided it can be allowed to develop naturally. We do not, of course, claim that the Department could within its own activities include the conduct of investigations on an industrial scale to establish the economic possibilities of new discoveries, ideas or inventions in any branch of industry. But we do hold that through one or other of its organisations the Department can adequately supply the scientific and technical co-operation which may be needed in such large-scale industrial trials.

II.—Contact with Industry.

1. *Research Associations.*—A research association is an organisation, established under the Companies Act, for co-operation in research by firms in an industry or a group of related industries, limited by guarantee and trading without profit in the form of dividends. The essential characteristic of these bodies is that they enjoy full responsibility for the discharge of their functions. They appoint their own staffs, make their own arrangements for carrying out research work, and draw up their own programmes. They also settle how the results of research are to be made available to members, though the Department retains a right of veto over the communication of results of research abroad.

Of the various reasons which determined the choice by our predecessors of this form of research organisation for those industries to which it was suited, two—which are inter-related—were of special importance. By establishing an association for co-operative research, conducted by an industry itself, the characteristic qualities of industry in this country were given the fullest scope. The outstanding merit of British industry in the past had lain, as it does still, in the individual character of the effort, in its independence, enterprise and initiative. But the development of industry in other countries had already made it difficult for British manufacturers to meet the competition of foreign manufacture, often organised on a large scale with the full resources of available technical knowledge. The war had demonstrated in the field of munition supply the impossibility of developing a large output if the technical knowledge and experience of different individual firms were not pooled in the national effort. The research association movement was designed to extend to manufacture, under peace conditions, the lesson then learnt, that by co-operation in technical knowledge much more was to be gained than lost. The attempt to establish the associations as autonomous bodies, managed by the industries for their own benefit, was successful because it preserved the individualism characteristic of British industry. Ample evidence reaches the Department of the pride of ownership in and management of their research associations by the industries which have created them.

This aim of the research association movement leads to the second great advantage these bodies possess. They lend themselves naturally to the promotion of contact between the scientific worker and the industrialist—a vital point. It is not an uncommon thing to find that a considerable part of the time of the staff of a research association is occupied in work for the firms which constitute it and in visits to works. In applying scientific ideas to technical problems, the staff, indeed, is intended to function as the "General Staff" of the industry.

A noticeable feature during the past year has been a wide recognition by research associations of the necessity to give increasing attention to the day-to-day problems encountered by firms in their ordinary processes of manufacture. Every director realises that if he and his staff can assist the members of associations to overcome their practical difficulties, and explain the cause and the remedy of the trouble in language that can readily be understood, they will go a long way towards gaining the confidence and support of the industry in an attack upon the underlying problems which are common to the industry as a whole.

Some remarkable results, bringing substantial financial benefits to the industry concerned, have already been achieved by research associations, and it is quite possible that the efforts of these bodies may at any time lead to the rapid development of a promising new industry or to the successful reorganisation of an existing industry through the use of new or improved materials or processes of manufacture. The outstanding difficulty, however, that all research associations experience to a greater or less degree is that of bringing home to their members the practical

* From the Report of the Advisory Council, 1930–31.

significance of the scientific conclusions that have been reached.

We regard the experience of research associations as reflecting accurately the problem of the application of scientific method and scientific knowledge in a considerable range of the industries of this country. For this reason we think it has special significance in any attempt to assess the difficulties of promoting the application of science in industry and to determine the causes of those difficulties. We are satisfied with the successful achievement of the research associations as a whole, and we are convinced that the expenditure incurred has been more than justified by the practical results already obtained and utilised.

2. *The Research Stations of the Department.*—The justification for all the expenditure on industrial research carried out in the Department's own laboratories must rest in the essentially practical aim of the work; and their primary purpose must be to secure the application of scientific knowledge in industry. We have therefore to consider in all our work how to organise its conduct so as best to promote the effective use of the results. From the earliest days we have adopted one obvious means of securing this. By obtaining contributions from an industry towards the cost of research, of which the results should be applied in the industry, the technical co-operation of the industry has been secured and its interest in the application of results for which it has paid has been stimulated. Here again the Department's experience is that the wide differences in industry call for different methods of making contacts in different cases.

Where individual firms make use to a substantial extent of the facilities of one of the Department's stations for testing work or the investigation of specific problems on payment of the appropriate charge, a valuable opportunity presents itself of introducing into industrial practice the results of research carried out there. In so far as the results of research work provide the starting point of the specific investigation or the technique of the test, a direct contact with scientific knowledge is obviously secured. But this direct contact is only part of the benefit. The discussion of manufacturing problems between the scientific staff and the industrialist not only stimulates the conduct of research along lines of usefulness to industry, but acquaints the industrialist with the existence of a large body of scientific knowledge and scientific research the value of which to himself he may previously not have realised. This is markedly the case at the National Physical Laboratory. The extent to which useful contact of this kind is made with industry is instanced by the fact that nearly one-third of the expenditure of the Department at this Laboratory is balanced by fees from industry for tests and special investigations.

III.—Application of New Inventions.

New industries are not in general created by direct scientific attack. They can usually be traced to remote origins. One conspicuous example to the contrary is the Bessemer process of making steel; another is the production of fixed nitrates, which was developed by direct attack under the stress of war conditions in Germany. A potential example is the Bergius process for the hydrogenation of coal. But the normal experience is illustrated by such industrial developments as radio communication. The general public has been made familiar with modern developments by everyday acquaintance with broadcasting, but forgets that it is thirty-five years since Marconi lodged his application for the first British patent for wireless telegraphy, and is, in the main, unaware that the scientific origin of the radio industry of to-day is to be found in the middle of last century when Joseph Henry first produced high-frequency electric oscillation, and Clerk Maxwell propounded his theory of the electro-magnetic field, out of which grew the conception of electric waves, afterwards verified by the experiments of Hertz.

It is clear that the history of the relation between invention and industrial development promises no short cut to renewed prosperity. At the same time those interested in financing the development of new industrial processes might with advantage make more use than they do of available facilities for obtaining authoritative evidence on the technical performance of new devices. As an example we instance the case of plants for the low-temperature carbonisation of coal. In the early days of low-temperature carbonisation processes, extravagant hopes were based upon practical developments which were premature because they had not waited upon sufficiently thorough scientific experiment. One of the objects of the establishment of a Fuel Research Station by Government was to provide authoritative information about the technical problems of the process which would be of service to all who were working at the same problem. To complete this useful service the Government decided, seven years ago, that the Department should be organised to test any plant for low-temperature carbonisation of coal which was considered to be sufficiently promising. The Department reserved the right to publish the results. Under these arrangements ten plants have now been tested and eight reports published. The reports deal with the technical efficiency of the plants. For judging of their economic success under commercial conditions of working over a long period, practical trial by an undertaking with the necessary capital resources can alone supply the necessary data. But the financial backers of the development can approach with much greater confidence the essentially uncertain enterprise of large-scale development if they have before them the results of an authoritative test of the technical performance of the invention. For reasons which distinguished processes for low-temperature carbonisation from many other industrial developments of a scientific character, the Government of the day decided that these tests should be carried out without charge upon conditions they laid down. We are not recommending the general offer of similar facilities to industry as a whole, but we are convinced that those who are interested in financing new industrial development do not appreciate to the full the reliable guidance on technical issues which can be obtained from investigations carried out on the appropriate financial terms in the stations of the Department, the laboratories of research associations or the works of individual firms.

IV.—Conclusions.

Throughout this report we have been emphasising the need for scientific method in industry. Research is to-day a necessity for the country whose industries are to survive the competition of energetic and scientifically informed rivals in the world market. We are well aware that we are emphasising a truth which is fully recognised in many cases. At the same time we feel there must be many who with the best will in the world to apply the results of scientific research are in some doubt of the means to be adopted in their particular case. To these, our advice is first to examine in detail in the light of existing knowledge and with the help of the best scientific advice available, the whole of their manufacturing processes. Where this is not already periodically carried out, we believe such an examination will reveal methods by which improvements, perhaps small in themselves, but amounting on the scale on which modern industry is conducted to hundreds of thousands of pounds, may be attained.

We have already said that we regard a research association as providing in the technical sphere the "General Staff" of its industry. It follows, therefore that our advice to any firm embarking on such an examination as we have outlined above would be to join its appropriate research association. It goes without saying that in order to profit by membership of a research association a firm must itself employ the best scientific advice available in directions in which specialised knowledge can have the fullest effect. Finally, we would remind industry that the Department is ready to place at the disposal of *bonâ fide* inquirers all the scientific and technical information it holds available for assisting industry, and where necessary to carry out for individual firms at a suitable charge experimental investigations to solve technical problems of manufacture.

There are those who would urge us forthwith to recommend greatly increased State expenditure on research for the solution of industrial difficulties. In our view, such a development, without qualification, could not be defended. The expenditure which is defensible in the national interest depends on the degree to which industry generally is prepared to apply scientific method and advances in scientific knowledge. So long as we are convinced, as we are to-day, that industry is showing itself increasingly ready to make effective use of science, so long shall we be able to justify to the nation the policy of steady development to meet new needs as they arise which has guided our predecessors and ourselves since the appointment of the first Advisory Council in 1915.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

PROFIT-SHARING.

Sir,—The reason for the opposition offered by trade unionists to profit-sharing, emphasised in the letter and its editorial tag last week, is not far to seek. It is based on principle, history, and experience.

Mr. N. P. Gilman, a prominent apologist in his day for profit-sharing, has declared that it is solely the workmen's own efforts which bring success to such a scheme. In his book "Profit-sharing" (page 430), he says: "Let us recur for a moment to the justifying reason of profit-sharing. That is, that the employee, by superior industry, care, and economy, and in view of a bonus, *creates* a fund out of which his bonus is to be drawn." Mr. Gilman stresses the word "creates" by italicising it.

The first profit-making scheme in an industrial concern in this country was that inaugurated in 1865 by Henry Briggs, Son and Co., of Whitwood Colliery, Yorkshire. Ten years later, when the men joined the Miners' Union, the directors protested and the shareholders withdrew the scheme.

In the gas companies a similar spirit was present. Sir George (then Mr.) Livesey proposed a profit-sharing scheme to the workers of his company. One of the conditions was that the participants should bind themselves to the company for twelve months. As the agreements bore different dates, any possibility of a strike was effectually prevented. I am informed that a similar condition exists to-day.

The experience of profit-sharing during the last fifty years is also unfortunate. The financial return to the worker has been too small even for propaganda purposes. In 1919 the 8552 participating workpeople in the engineering group received an addition to wages of about 1s. 8d. per week; for 1930, 18,000 employees received an extra 1s. 9d. per week. For all schemes known to the Government to be in operation, the figures were 1s. 11d. and 4s. 1d. per week for each year respectively.

It will, I trust, be clear that at the moment I am not arguing for or against the profit-sharing idea. My present purpose is to point out some of the reasons for what seems to be simply an instance of class prejudice and muddle-headed obstinacy. Without an understanding of the obstacles, any attempt at progress would be futile.

Edgar D. Ward.

West Wickham, Kent, January 11th.

Sir,—The letter of your correspondent "F. N. B." will arouse considerable interest. He calls attention to the remarks made by Mr. Wickham Steed in broadcasting, and it is obvious that in this broadcast and in his many addresses and articles, Mr. Wickham Steed is inducing many people to look at the subject of profit-sharing who have hitherto given it too slight an attention.

We, of the Industrial Co-partnership Association, should certainly join with your correspondent in asking for a fresh inquiry, not only by the Federation of British Industries and the Engineering and Allied Employers' Association but also by the Trades Union Congress. While there has been unfortunately in the past, as you point out in your editorial note, opposition by the trade unions—not always justified—there is reason to believe that there is a fresh outlook upon such questions as this, even from that quarter.

You remark editorially that profit-sharing has been tried and found disappointing in practice, and you conclude once more that it has only succeeded in certain industries like gas. I should like to call attention to the fact that it is in successful operation in many other varied and competitive industries. I can only mention now the Brush Electrical Engineering Company, Ltd.; J., T. and J. Taylor, Ltd., woollen cloth manufacturers; Clarke, Nickolls and Coombs, Ltd., wholesale confectioners; Bryant and May, Ltd., match manufacturers.

We should be very pleased to supply further information to your correspondent and others, and put them in touch with the literature on the subject to which you refer.

F. W. Raffety,
Acting Chairman.

Industrial Co-partnership Association,
London, W.C. 1, January 11th.

Sir,—I read with interest the letter on profit-sharing, with appeared in your issue of January 8th.

This whole question was investigated exhaustively by the Committee on Industry and Trade under the chairmanship of Sir Arthur Balfour, and I would urge your correspondent to consult the Final Report of that Committee, wherein the conclusions reached are set out.

Robert R. Hyde.

London, January 11th.

BRITISH TURBINES ON THE CONTINENT.

Sir,—I have been reading the article in your Christmas Day issue entitled "British Turbines on the Continent," and find that no reference is made to the two 42,000 kW turbo-generator sets with condensers that we have recently shipped to Rotterdam for their new municipal power station. These are the largest turbo sets in that country and are likely to remain so for some considerable time.

These two sets aggregate about 900 tons in weight, and although the power station is only a few hundred yards from the quay, it was necessary to procure a special truck from Krupps to convey the alternator stators, each of which weighed 70 tons, to site.

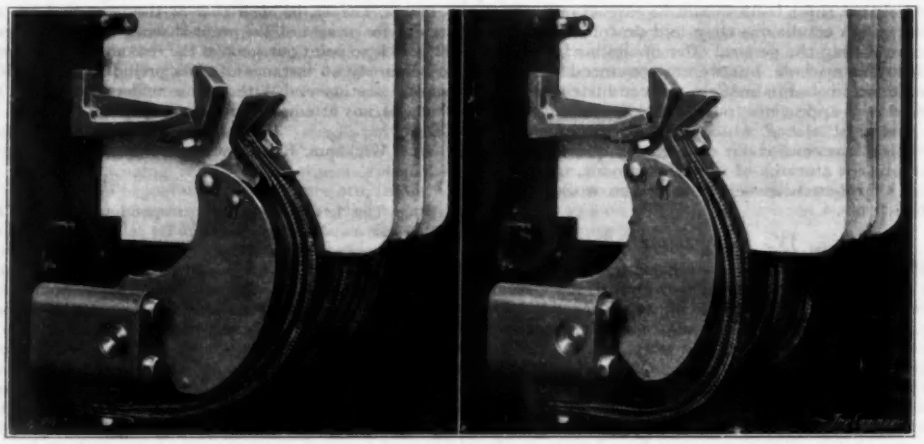
Metropolitan-Vickers Electrical Company, Ltd.,
A. E. du Pasquier.

Manchester, January 11th.

In a paper read before the Junior Institution of Engineers by Mr. B. C. Oldham, on January 8th, stress was laid upon the great variety of industrial and other processes in which artificial cooling by various means was utilised, for instance, in bakeries for attemperation of water and flour, control of fermentation, removal of heat from dough mixers, &c.; in breweries, the oldest users of refrigeration, for cooling the wort, chilling the beer to produce a bright non-deposit liquid, and for carbonating, conditioning and storing; the clarification of champagne by freezing collected sediment. In confectionery it produced the "bloom" on chocolates, and was used for maintaining consistency of products generally. Chemical works are large users of refrigeration in controlling temperatures during chemical reactions, such as in manufacture of bleaching powder, acetylene gas and baking powder, &c. The separation of liquids is now effected by fractional crystallisation instead of fractional distillation utilising the relative freezing temperatures instead of the relative boiling points. In bridge building, sinking mine shafts, and in other excavation work refrigeration has, from early days, been employed to solidify quicksand and other material which does not lend itself to excavation in its normal state. In the iron and steel trades and engineering works refrigeration is employed for drying air for blast-furnaces, controlling temperature of quenching baths, &c.

New Control Gear for A.C. Motors.

AT the invitation of Brookhirst Switchgear, of Chester, we recently inspected some new A.C. motor, air break control gear, which differs from the usual apparatus in that normal making and breaking of the circuit is done by a triple-pole electrically-operated contactor designed to avoid deterioration of the contacts and arranged so that it can always be seen by the operator.



FIGS. 1 AND 2—CONTACTOR CONTACTS, OPEN AND CLOSED

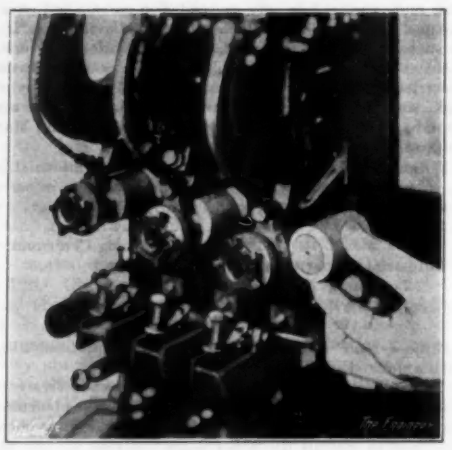
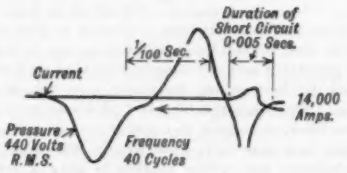


FIG. 3—FAULT PROTECTION FUSES

Freedom from trouble is said to be ensured, and maintenance is reduced to a minimum. The contactor has been designed with a view to meeting the exacting conditions of modern services, the contacts being of the rolling butt-type, shaped so as to eliminate bounce in closing, whilst, when breaking the circuit, the mass of metal at the effective spot cools the arc and reduces burning and wear to a minimum. The laminated flat strings composed of high-quality steel are liberally proportioned, and are designed to maintain an almost constant pressure throughout their entire movement. When breaking the circuit, the contacts are forced apart at maximum spring pressure, which helps to give a clean, quick break. The rolling action of the contacts ensures that the circuit is made at one point and maintained under pressure at another point, so that a clean line running surface is obtained. The engravings, Figs. 1 and 2, show the contacts open and closed respectively, and also illustrate the heavy copper brades and special fixings. The magnetic path in the fixed and moving parts is composed of high-permeability insulated sheet iron laminations, which are securely fixed to strong frames. The contact levers are clamped to a common insulated rigid spindle rotating in long split bearings. The triple-pole contactor isolates all three lines of the supply, and its operating coil provides a no-volt release. In addition to its normal ability to sustain high peak loads and break overload currents, it is suitable for inching.

Another feature of the gear is dual excess current protection, which meets two different sets of conditions—accurate overload protection and fault protection. Although in previously-existing arrangements, both these conditions had been met to some extent by a common protective feature, the increased capacity of modern supply lines makes it desirable to provide independent protection for short-circuit conditions, for the overload trips can then be set to operate accurately at the required overload values, the fault conditions being looked after by the independent apparatus. In all the new contactor break A.C. motor-control gear, as set forth in the table above, dual excess current protection is provided by fault-protection fuses and thermal-overload trips.

Type.	Description.	No. of sizes.	Horse-power range. 200/250 V.	400/480 V.	500/550 V.
SHA 10	Straight-on	5	7½–90	15–150	15–175
YHA 10	Star-delta	5	7½–90	15–175	15–200
PHA 10	Primary resistance ..	4	2½–50	5–100	5–125
THA 10	Auto-transformer ..	5	2½–90	5–175	5–200
RHA 10	Stator/rotor resistance	5	2½–90	5–175	5–200



S.C. Test. 400 Amp. Fuse Interrupting a 25,000 kVA. Short Circuit.

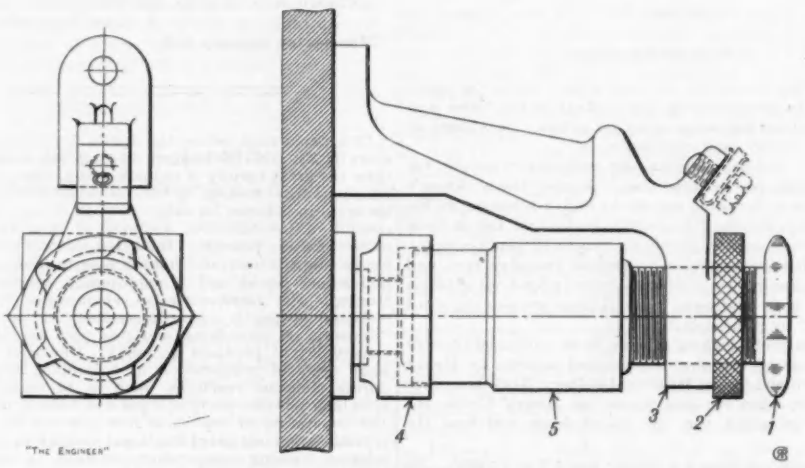


FIG. 4—DETAILS OF FUSES

panel in this new range of A.C. motor-control gear have been adopted after careful tests, which are said to have shown that these fuses are thoroughly reliable. They can rupture 25,000 kVA at 440 volts, and a tell-tale indicator is provided to show when the element has fused. Three spare fuses are provided in a convenient cavity inside the front door of the panel, and a blown fuse can be replaced in a fraction of a minute in the manner shown in Fig. 3. Details of the fuse are given in Fig. 4, which also shows the result of a test on a 400-ampère fuse interrupting a 25,000-kVA short circuit. It will be understood that the fuses only open the circuit under short-circuit conditions, and operate independently of the main contactors on the motor control panel. The overload protection can therefore be arranged to operate with accuracy, and can take account of the actual temperature rise of the motor windings, for the overload trips operate on a time-temperature basis. Under given circumstances the heating element can be designed to heat up at approximately the same rate as the motor windings, and the overload trip switch opens at a temperature at which the insulation of the winding would burn out. Full advantage can therefore be taken of the limits of temperature and overload which the motor is capable of standing, but, as those limits must not be exceeded, the protective device must have a high degree of accuracy. In the design of the gear this matter has received special attention, and care has also been taken to make the components of the overload trips robust, so that they cannot be damaged by overloading or by handling in the course of the usual maintenance work. The heating elements of these thermal-overload trips—see Fig. 5—are wire-wound, and are independent of the bi-metal strips which, as the current increases, bend upwards, and, if the increased current is sustained, ultimately cause the overload trip switch to open. This acts on the main contactor, which opens all three lines of the supply and stops the motor. As each trip is provided with an adjustable screw, the trip on each phase can be accurately set, independently, before the gear leaves the works. The combination of fault-protection fuses and accurate and robust overload trips is claimed to provide ideal excess-current protection, and the scheme is embodied in all the panels given in the above table.

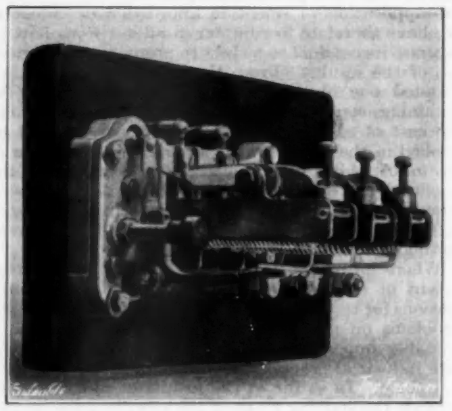


FIG. 5—THERMAL OVERLOAD TRIPS

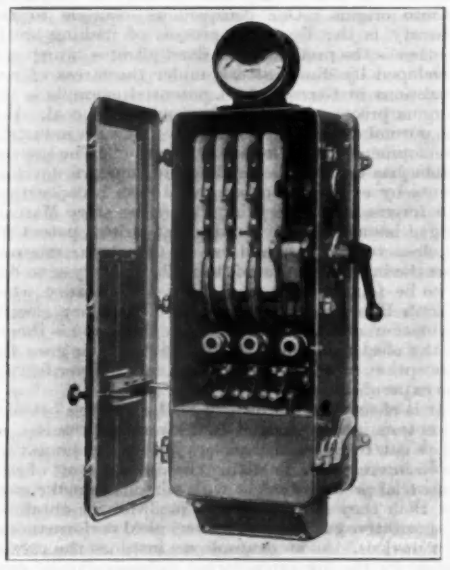


FIG. 6—STAR-DELTA PANEL

When the inspection door of a control panel is open, accidental contact with live parts should not be possible. The initial cost of a starter with an isolator is naturally greater than the cost of a starter without one, but regulations demand that, somewhere in the vicinity of a motor, an isolating switch must be fitted. Only when an isolator completely cuts off the supply and is interlocked with the inspection doors, is a control panel really safe and the makers of the gear under consideration have definitely adopted that practice on their D.C. motor control panels. The same safety isolating features are incorporated in the panels under consideration, the safety isolator being placed in a separate compartment which is locked, and it is only when an authorised person unlocks the hinged inspection door that the live terminals can be exposed.

Interlocking with the main contactor ensures that the circuit is always made and broken on the contactor and not on the isolator, whilst interlocking with the inspection doors of the enclosing case ensures that the isolator must be moved to the off position and the supply completely isolated before the isolator can be moved to the "on" position.

For slip-ring motors the stator and rotor resistance panels are provided with a pivoted handle, which, when raised and moved one notch forward, enables inching to be performed by simply raising and lowering the handle. This position is the starting position and subsequent acceleration is obtained by ratcheting forward step by step until the full "on" position is reached, when the starting handle may be released. If the starting handle should be released in any intermediate position, the stator contactor opens and the possibility of running with the rotor resistance in circuit is therefore avoided. A push-button enables the motor to be stopped in the case of emergency.

The "straight on" starting panel for squirrel-cage motors is simply operated by a start-stop push button, whilst the star-delta, primary resistance, and auto-transformer panels are operated by pressing the starting push button, and by the subsequent movement of the starting handle from the starting to running position when the starting push button is released. In the case of star-delta panel—see Fig. 6—the motor is inched by pressing and releasing the starting push button.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

January Quarterly Meeting.

THERE was a large and representative attendance at the January quarterly meeting of the Midland iron trade, held in Birmingham on Thursday, and the prevailing tone was one of qualified optimism. Producers and consumers of iron and steel were anxious to discover as far as possible the portents of trade in the various industries and districts over at least the next three months in order that they might plan their respective business operations. As far as can be gathered, they met with little enlightenment. It is true that in some districts, including Birmingham and the Midlands, there are definite signs of trade expansion, but it is difficult to determine to what extent and how rapidly the movement will develop, and, consequently, those engaged in these trades are acting with caution and are not disposed to commit themselves, even so far as to forecast their probable requirements. Then there is an inclination on the part of many industrialists to postpone decisions until the uncertainties of the national and world positions have been, at any rate partially, cleared, and until the Government's policy regarding tariffs has been more firmly defined. The recent declaration of Germany as to reparations has created further unsettlement, and has acted as a deterrent to the development of programmes and the making of decisions. Iron and steelmasters are still hoping for some measure of protection from foreign competition, but, even if this were forthcoming in the near future, stocks of Continental material here are so considerable that the effect would not be felt for some time. Unfortunately, there seems little prospect at the moment of an increase in activity in the heavy engineering industries, which normally consume heavy tonnages of iron and steel, the development so far being more or less confined to the lighter Midland trades. Heavy engineering firms, for the most part, are short of orders. The constructional establishments are slack, and their contribution to the demand for steel is small. The steel works hold orders, but engineers are so placed as regards substantial works that they are unable to specify for the delivery of anything but small tonnages. Every week brings news of development schemes being temporarily shelved, purely on financial grounds, and there can be no doubt but that many Midland engineering firms realise that works which they had anticipated securing from local authorities in 1932 are for the time being lost. Their prospects have been dashed to a relative extent. There are hopes of securing contracts for the building of new works for foreign firms which may decide to produce here, but they are somewhat slender, as there are so many factories in this district which could be reconstructed very much more cheaply than new works could be erected. Moreover, many of the vacant factories are in excellent condition and well situated. Rolling stock engineers, as the result of recent orders, are slightly better placed than they were, but there is not that volume of work necessary to keep these establishments fully employed. Boilermakers are moderately engaged and the outlook is not too bad. The prospects, generally, for makers of iron and steel are not such as to encourage them to the belief that demand is likely to advance sufficiently to justify a higher level of values for some little time to come, and so, for the time being, they have made no alteration to recent price levels. Buyers on their part appear to have no qualms with regard to prices. They feel fairly certain that, as necessity arises, they will be able to secure all the material they require on favourable terms. The quarterly meeting therefore did not produce much actual business. There was little, if any, contracting forward or bulk buying, except perhaps in the raw iron department, though there were numerous inquiries which producers were disposed to look upon as being in the nature of market tests. Up to the time of writing there had been no development of note, and there was every prospect of the meeting leaving industrialists almost as much in the dark as to the future as they were before the gathering. A few of them would be slightly better off for orders, but there was no evidence of a re-invigoration of demand for iron and steel, or of such development taking place during the first quarter of the year.

Brighter Outlook for Birmingham.

The New Year has opened propitiously for Birmingham, each week so far having brought additional trade momentum. Moreover, there are definite signs and prospects of further amendment of the industrial position as the year advances. Reports from official sources are to the effect that many firms are already working overtime, while others are increasing their staffs to cope with a steadily increasing influx of orders. Amongst the busy firms are some engaged in the heavy section of the automobile industry, electrical furnace builders, makers of safety razor blades, producers of valves and other radio equipment, manufacturers of steel furniture, unbreakable domestic and fancy wares, &c. The further extension of trade is, however, not confined to normal Birmingham industries. Several foreign firms have taken factories in Birmingham, and are manufacturing goods previously made abroad. The City of Birmingham Information Bureau is in communication with nearly forty foreign firms which have announced their intention of manufacturing in this country. Many English firms have also approached the Birmingham authorities for particulars of factories and sites in Birmingham in anticipation of a revival in trade. Optimism is spreading in this district, and plants have in many cases been recently overhauled and workshops prepared for the trade advance.

Raw Iron in Demand.

The department of the market showing most activity at date is that of pig iron. Demand is gradually expanding, and some blast-furnacemen state that, not only is current production being fully taken up, but small quantities are also being taken from stocks. The light castings trade is responsible for a very large share of the output, and the improved position at many Midland works during the last three months has undoubtedly been of great assistance to pig iron producers. Iron for the engineering foundries is being taken sparingly, but hopes are entertained of improvement in this branch in the near future. Derbyshire smelters dispose of the bulk of their output to associated pipe foundries, while Northamptonshire producers of raw iron continue to compete for the Scottish trade with some success. Although the position at Midland blast-furnaces has improved a good deal of late, there seems to be little prospect of additional plant being brought into operation in the immediate future. Furnacemen say that there will have to be a considerable trade movement in the right direction before the services of additional blast-furnaces will be required. Midland smelters have on their books substantial orders, in some cases for supplies to the end of the quarter, and they report that new specifications are maintained on a fairly good scale. Although coke is dearer than it was three months ago, the Pig Iron Producers' Association has not raised selling prices of iron, which remain where they have stood for the past six months. Northamptonshire No. 3 foundry iron is £3 2s. 6d. per ton delivered Black Country stations; forge iron is £2 17s. 6d.; Derbyshire and North Staffordshire irons sell at the same figure, namely, £3 6s. for foundry and £3 1s. for forge. Large buyers of pig iron are allowed rebates varying according to the quantity taken each month. The Smelters' Association, having recently reaffirmed selling prices, no change is anticipated before the next ordinary monthly meeting of that body at the end of the month. Transactions this week have been mostly in the nature of small tonnages required for almost immediate consumption, users having covered their fixed requirements for January before the Old Year closed. When compared with other producers of material, blast-furnacemen are well placed, and have cause to congratulate themselves. At the quarterly meeting producers and consumers met on very friendly terms, in contrast to the spirit of antagonism which existed a year ago when users felt they had a grievance in that iron prices were being unjustly upheld. They now appear quite satisfied that they are getting "a fair deal," and they have forsaken the policy of hand-to-mouth buying and refusing to contract forward which they persisted in for many months.

Steel Dormant.

There is little movement in the finished steel trade. Demand remains sluggish, specifications against existing contracts are poor and irregular, and the whole position is unsatisfactory. There needs must be a revival in the heavy engineering industries before steel masters can hope for improved conditions. Conversations on 'Change at the quarterly meeting failed to reveal amongst users anticipations of an early betterment of the situation, and steel masters are none too cheerful as a result. Angles, joists and plates are all in poor demand, despite the fact that selling prices are considered to be very reasonable, and more likely to appreciate than to fall. The consuming industries are only able to absorb small tonnages of material unless they are prepared to put some into stock, and under existing conditions they are not willing to do this. There are adequate supplies of all descriptions of finished steel, and almost immediate delivery can be obtained, if required. Values are unchanged, angles being £8 7s. 6d., less 15s. rebate to users confining their purchases to British material; tees are £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; and ship, bridge, and tank plates, £8 17s. 6d., less 15s.; boiler plates, prices of which are not controlled, sell at £8 12s. 6d., which is 15s. per ton below the figure ruling at the same meeting last year. In the half-products department of the market there is more movement, due in part to the larger share of business coming to district makers, owing to the difficulties of trading with Continental suppliers. Transactions with the foreigner are very small at date, but a good deal of this is due to users here having considerable supplies in hand or on order purchased as a safeguard in the event of a tariff being imposed at the end of last year. It will take some time to work these stocks down. Staffordshire re-rollers are fairly busy and have a reasonable amount of work on their books. Moreover, they look for an increase in orders in the coming weeks. They maintain the selling price of small bars re-rolled from foreign material at £6 17s. 6d., while all-British bars are quoted £7 10s. as a minimum. Billet makers experience a moderate demand, and ask £5 7s. 6d. to £5 10s. per ton for their output. Sheet bars command £5 5s. to £5 7s. 6d., and Staffordshire hoops £9 10s.

Finished Iron.

There has been no development of demand for finished iron and the works in Staffordshire continue irregularly engaged. While makers of best grade bars and producers of iron strip are able to make some sort of a show, ironmasters engaged in the production of Crown grade bars and of nut and bolt quality iron find business consistently bad. Ironmasters are hoping for some extension of demand for high-class iron, but they are rather despondent as to the prospects for other grades. So far this year, trade in Staffordshire has operated on a hand-to-mouth basis, and few of the ironworks have any reserve of orders. Marked bar prices are maintained at £12 per ton at makers' works, and there seems little prospect of any alteration in the near future. Competition in the Crown bar branch keeps prices on an unremunerative level, so far as Staffordshire makers are concerned, and some of them refuse to enter into competition for business. They quote a figure somewhere in the neighbourhood of £10 per ton and see the orders go to firms willing to accept as low as £9 5s. Makers of common bars for the nut and bolt and fencing trades are unable to meet Belgian competition, and their selling figure of £8 7s. 6d. is very much above that of their competitors. Business is slack at the consuming works, making matters worse. The call for wrought iron gas tube strip is hardly as brisk as it was, but there are chances of improvement in this branch. Quotations range from £10 10s. to £10 12s. 6d. per ton delivered.

Galvanised Sheets.

The general position of the galvanised sheet trade leaves much to be desired. While home demand keeps up steadily, that from overseas is fitful and not up to its normal volume. Competition for business is keen, and prices are weak. The mills are so anxious for orders that in some cases £9 is accepted for 24 gauge corrugated sheets, though the general price level is half-a-crown higher. None of the overseas markets are buying well, and district mills are only kept in operation with difficulty. At the January quarterly meeting last year 24 gauge sheets made £11 5s. per ton, and business, though below normal, was better than it is to-day.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The Economy "Axe."

THE engineering and allied trades, through the machinery of the Manchester Chamber of Commerce, have played a very active part during recent years in the campaign to bring about a reduction of the rates burden in the city area. Their strong argument has been that the heavy municipal expenditure, much of it on social services, using the term in a wide sense, increases the overhead expenses of industrial undertakings out of all proportion to those borne by foreign competitors. It will have been with mixed feelings that engineering employers will have studied the second report of the special Economy Committee of the Manchester City Council during the past week. It is true that this Committee has justified its formation, for the various economies suggested, if they are approved by the City Council at its meeting this week, will mean a very considerable reduction in civic expenditure. This is all to the good, of course, but it is ill news that, directly owing to the decline in industrial prosperity, there has been a serious fall in the rateable value of the city which will, it is expected, entail a further heavy increase in rates for next year.

Another Electrification Proposal.

As the result of a conference of various local authorities through the areas of which the London, Midland and Scottish line from Stockport to Buxton passes, it is probable that at an early date the railway company will be approached with a view to considering the question of carrying out an electrification scheme.

Crewe Rejoicing.

Last week in this column it was recorded that a Scottish company was understood to have decided to erect a factory in the neighbourhood of Crewe for the treatment of local deposits of peat for the production of a sound-proof material by a new process, and that extensive plant had already been ordered. It is now announced that a further new industrial development in the area will comprise a match factory, which is to be opened on the outskirts of the borough. Machinery is now in process of being installed. On top of this comes the news that the London, Midland and Scottish workshops in Crewe are showing some indication of reviving activity, and that a number of men who have been unemployed for some time have been re-engaged in various departments.

Textile Machinery Nearing Perfection?

Addressing a meeting of Lancashire mill managers in the Manchester Athenæum last Saturday, Mr. H. C. Barnes stated that whilst there had been a considerable number of new textile machinery accessories put on the market during the past twelve months, there had been no real revolution in the accepted methods of either spinning or weaving. Textile machinery, said Mr. Barnes, had now reached a highly developed stage, and in his opinion there seemed to be little prospect of startling developments in that branch of engineering.

Non-ferrous Metals.

The feature of the non-ferrous metals market during the past week has been the substantial recovery, more especially in the tin and copper sections, after the weakness and depression witnessed throughout the market in the previous week. A return of confidence in favourable statistical developments in respect of tin, coupled with some revival of buying interest in the metal, had a pronounced bullish influence on prices, a rise of nearly £6 a ton having occurred since a week ago. Not only has last week's substantial loss in this section been wiped out,

but there has also been a gain compared with a fortnight ago, and values at the moment of writing are only fractionally below the recent high level recorded just before Christmas. In the copper section, the gain on the week, at nearly £5 a ton, has been relatively greater than in tin, and here again a better demand from users and favourable American advices have been noteworthy features. The demand for lead cannot be described as more than moderate, but the statistical position of the metal seems to be fairly satisfactory just now, and a rise of 10s. a ton on balance has served to recover last week's loss and to bring values back to where they were at the close of last year. Spelter has met with a somewhat better call from industrial users, and the tendency at the moment appears to be rather firmer, with a net advance in prices since last report of from 5s. to 7s. 6d. a ton.

Iron and Steel.

There has been a shade more movement in the iron and steel markets here during the past week, the intense dullness of the two previous weeks having been left behind. Up to the present, however, new business in foundry iron has been very moderate, although deliveries into consumption have been renewed and, in the aggregate, are not far short of what they were before the holidays. Prices are steady at 67s. per ton, delivered equal to Manchester, for Derbyshire, Staffordshire and Cleveland makes, 65s. 6d. for Northamptonshire, about 87s. for Scottish, and 81s. for West Coast hematite. The bar iron trade continues on a very quiet scale, but at £9 15s. per ton for Lancashire Crown quality bars, and about £8 5s. for No. 2 material values are maintained at late rates. In the steel section this week there has been a little more inquiry about for a miscellaneous assortment of products, including bars and boiler and general plates, although whether it will lead to any material increase in business remains to be seen. The demand for constructional qualities is as poor as before. Acid and basic boiler plates are quoted at about £8 15s. per ton, tank plates at £8 17s. 6d., small re-rolled bars at about £7, large diameter bars, 3in. and upwards, at £9 7s. 6d., sections at £8 7s. 6d., and joists at £8 15s. There has been a slight increase in the demand for imported steels, principally for early delivery.

BARROW-IN-FURNESS.

Hematite.

Now that the holidays are over there is a slight improvement in the hematite pig iron market, and there is a noticeable increase in inquiries, which it is hoped will develop into firm business. Stocks have increased during the past few weeks owing to business being quiet and there being little demand on local steel account. Taken on the whole, trade shows distinct signs of being on the quiet side for some time. The home demands continue to be light, and Continental and American business is smaller than it has been for some considerable time. The iron ore trade is quiet and local mines are slack. The important Hodbarrow mines have had a ten-days' holiday, which is evidence of the poor demand for local sorts. Foreign ores are experiencing a dull market and imports are restricted. The steel market is very quiet and few orders are obtainable at present. Both Workington and Barrow have orders in hand, but they are not heavy. The Barrow rail mills are still idle, but the mills on hoops and small sections are engaged.

SHEFFIELD.

(From our own Correspondent.)

Quietness in the Heavy Trades.

THE resumption of work in the heavy steel trades has not been on a satisfactory scale, and conditions in the East End of Sheffield generally are much the same as they were before the Christmas stoppage. No substantial quantity of orders arrived during the holiday, and the policy of buying for forward requirements, which was adopted by a number of consumers when the country went off the gold standard, has practically come to an end, and has been succeeded by a return to the practice of only obtaining sufficient supplies to cover current needs. The numbers unemployed during the last holiday reached the highest figures ever recorded for the same period of the year, and a considerable proportion of those who were then suspended have not yet resumed work.

The Lighter Branches.

In several of the lighter departments, conditions are better than on the steel-producing and heavy manufacturing side, but there is a great deal of slackness in them as well. The high-class tool steel and alloy steel trades are not at all well placed, and are not gaining that increase of export activity that they so much desire. This state of things is emphasised by the stagnation of the market for ferro-alloys, users of which will not buy forward, although further increases of price are said to be probable. There is rather more being done in the saw and file trades. Russia has just placed a good order for inserted teeth circular saws of sizes up to 48in., following an order just completed, and there are more inquiries in the short saw and gin saw sections. Cold-rolled steel and strip is doing better, and is likely to gain considerably from the reduced value of sterling. The demands from the automobile manufacturers, more especially with regard to heavy commercial vehicles, represent a considerable volume of work, though not up to former best standards. One of the strongest departments continues to be that of stainless and corrosion-resisting steels. Orders for those materials are still expanding. Increasing quantities are being used for, among other purposes, shop fronts and road studs, the latter of which are now being made by several local firms, which are supplying them to towns abroad as well as at home.

Tariff Disappointments.

There is a great deal of disappointment in Sheffield at the continued absence of legislative measures for the protection of the steel trade, and this was pointedly referred to by Mr. A. J. Grant, of John Brown and Co., Ltd., President of the Sheffield branch of the National Union of Manufacturers, at the annual meeting on Monday. He said that he had expected that, immediately after the General Election, the Government would have proposed a duty on imported iron and steel under the Abnormal Importations Act, and he was bitterly disappointed that that had not been done. He was obviously not alone in his expectation, as importers proceeded to flood the country with every imaginable variety of iron and steel products, in anticipation of a duty. The result, immediately after the General Election, was a most distinct boom for our home manufacturers, as every consumer thought it wise to place orders before the anticipated tariff came into being; "but," he added, "as week succeeded week, and cheap foreign material was still pouring into the country, as it is at the present time, orders to home manufacturers began to fall off, and we are faced at present with an absence of demand which is deplorable."

The Case of the Steel User.

While it was the Government's intention to see that users were not adversely affected, proceeded Mr. Grant, they had had so much evidence from users all over the country that they would welcome a tariff on account of the fillip it would give to trade, that he was convinced that the balance of advantage in favour of a tariff would altogether outweigh any slight inconvenience which might be felt by a few importing firms, which, generally speaking, were not employers of labour, and which had for years reaped a rich harvest by the purchase of cheap foreign material, to the detriment of industry and those employed therein. "I feel," he added, "that it is due to all those thousands of our men who voted at the last election against the Labour candidates, and in favour of the National Government, purely in the expectation that something was going to be done to assist their industry, that they should feel that they have not been misled, and that the Government do intend to take the most prompt action in the matter." He pointed out that Mr. Hore-Belisha, the Parliamentary Secretary to the Board of Trade, when in Sheffield last week, had the case for the industry presented to him very ably and energetically by the leaders who had met him.

Cutlery and Plate.

Activity in the cutlery and plate trades has not yet been fully resumed after the holidays, and the quantity of work on hand is comparatively small. Although imports have practically ceased, the demand for home products has not yet shown much advance, owing to the heavy stocks of foreign goods in the country. Some firms are, however, busy on general lines, while the scissors and wafer blade branches are well employed all round. The Royal Army Clothing Department has invited tenders for 90,000 one-piece steel table knives, 85,000 unplated table spoons, and 80,000 unplated table forks. The Royal Air Force is in the market for 3500 dessert spoons. The Sheffield branch of the National Union of Manufacturers, in its annual report, makes a strong complaint about the lapsing of the Safeguarding Duties on cutlery, and attributes to it a very large increase in unemployment in the city.

Development Prospects.

Several places in this district are hoping that, as the result of changing conditions, industrial activity in their areas will be developed. I have already referred to the steps which are being taken at Sheffield and Doncaster to deal with inquiries for new works sites. It is now reported that Lincoln City Council has received inquiries for works sites and facilities for factories in the city from three different sources. One was from a Middlesbrough firm, on behalf of an American company, which is seeking a suitable site in this country, and is interested in the Lincoln district; another, from a London firm of factory specialists, which has an extensive clientèle among American and Continental firms, desirous of obtaining manufacturing sites and anticipating having to find some sites in the district in the near future; and a third from another London firm of factory specialists which proposed to send a representative to inspect the vacant Abbey Works and the Stamp End Works. At Retford, too, the Town Council is taking steps to bring to the notice of intending site purchasers the facilities available in the town.

Railway Electrification.

A conference of local authorities has been held at Buxton on the question of the electrification of the Stockport-Buxton line of the London, Midland and Scottish Railway Company. The authorities represented were the Buxton Borough Council, the Whaley Bridge and New Mills Urban Councils, and the Chapel-en-le-Frith Rural District Council, through the areas of which the line passes. The conference was in favour of the electrification of the line, and agreed upon the desirability of approaching the railway company with that end in view. The matter is to be further discussed, and other joint conferences will probably take place.

Water Schemes.

Pontefract Town Council is to apply to the Ministry of Health for sanction to borrow £40,000 for the pumping station and buildings proposed to be erected at the Corporation waterworks site at Eggborough. A new storage and service reservoir at Roebuck Hill for the Dearne Valley Water Board, is nearing completion. It is of the underground type, constructed of reinforced concrete, and has a holding capacity of 1,000,000 gallons. The work has been carried out to a large extent by local labour.

Hull Transport Questions.

Mr. Morrison, the new general manager of the Hull municipal transport undertaking, has presented a report on the reorganisation of the service. He recommends the establishment of a common central terminal point, and a central omnibus clearing station as near the centre of the city as possible; also a scheme of centralisation of at least the general offices, omnibus workshops, stores, and housing accommodation for omnibuses, on a site as near as possible to the position decided upon for an omnibus clearing station. The Transport Committee of the City Council has approved the principle of centralisation, and has decided to wait upon the Housing and Town Planning Committee with regard to the provision of a central omnibus clearing station near Paragon Railway Station.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THERE has been a much improved tone in the Cleveland iron trade this week. After a slow New Year beginning, the market is gradually experiencing an increased momentum. Exports are improving, and home buyers are placing orders more freely. The opinion that values are unlikely to fall is emphasised by the fact that some of the inquiries in circulation are for supply over the whole of the year. Stocks of iron are still considerable, and producers find no justification to increase output. Consequently, the restarting of a blast-furnace at Dorman, Long's Cleveland ironworks at the end of the month is to be balanced by the stoppage of another, and the total number in operation in this area will remain unchanged at seventeen. Reduced rates are still quoted to Scottish consumers, and it is hoped to attract more business now that the works have resumed, but to all other destinations prices are firm at the official minima. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

Some improvement is also noted in the East Coast hematite pig iron trade. A few more foreign sales have been negotiated by makers, and home requirements are on a rather better scale. Supplies, however, are still abundant, and sellers are, in some cases, prepared to shade 65s. for mixed numbers. No. 1 quality is at a premium of 6d. per ton.

Ironmaking Materials.

The foreign ore trade is idle, and 16s. 6d. per ton c.i.f. Tees is a purely nominal price for best Rubio. The coke market is much firmer, and although there is little local demand, 17s. per ton is a minimum price for blast-furnace grades delivered at the works.

Manufactured Iron and Steel.

Semi-finished and finished iron and steel quotations are steadily maintained, though in nearly all branches orders are still greatly needed. An order for 1200 tons of steel work for L.N.E.R. bridges has been placed this week with Dorman, Long and Co., Ltd., of Middlesbrough, by Sir Robert McAlpine and Sons (London), Ltd., who are the contractors for the work. The bridges occur in the 7 miles section of railway from Gidea Park to Shenfield. The work will take two years and employ 1500 men.

Deck Machinery Order.

An important order—that of supplying the deck machinery for the turbo-electric liner the "Queen of Bermuda," which is being built at Barrow—has been secured by Clarke, Chapman and Co., Ltd., the Gateshead engineering firm. The Sunderland Forge and Engineering Company, of Pallion, has obtained the order for the electrical wiring of the new luxury liner. Other important orders in connection with the vessel are almost certain to be placed with firms on the North-East coast.

The Coal Trade.

An all-round improvement has taken place in the North of England coal trade. Plenty of orders are coming in, many more miners are at work, and there is every indication that trade will continue to improve. Recent active booking for all descriptions of Northumberland steam coal has practically cleared the market of supplies for this month. With only odd lots to offer, holders can clear any surplus at top recent prices. For full cargo business buyers only offer about medium late range of value, and for next month the offers are fractionally lower. Best qualities for prompt are 14s., for end of month 13s. 10½d., and for February-March 13. 9d. There is, however, no particular pressure from sellers ahead, who are inclined to hold off pending developments in the German financial situation. Durham prime steam coals are steady at 15s., with small firm at 12s. All descriptions of Durham gas coal are readily obtainable for next week and for more forward positions. Best kinds are quoted at 14s. 6d. and secondary at 13s. 6d. Coking unscreened are at a minimum of 13s. to 13s. 9d., and small at 12s. 6d. to 13s. 3d. Best Durham bunkers are quoted steadily, the position remaining bright for the rest of the month, best being 14s. 6d. and seconds 13s. 3d. The coke position is steady. There is considerable pressure for coke nuts, particularly from American buyers; but makers cannot supply prompt lots owing to lack of supplies. Prices, consequently, are firm for this or next month's shipment, 18s. 6d. to 21s. being indicated. Gas coke is a firm market at 19s. for best qualities, and stocks are in short supply. Patent oven coke is steady and plentiful at 16s. 6d. to 17s. 6d. Superior coke is steady at 18s. to 21s.

SCOTLAND.

(From our own Correspondent.)

A Quiet Restart.

THE holiday season is practically at an end. Most of the collieries, steel works, and ironworks which have been on vacation have restarted, though some of the last

mentioned will not be in action until next week. On the whole, conditions show little change, and the accumulation of orders during the stoppage having been most modest, the restart has been a quiet one. It has been said that the nature of inquiries shows signs of a revival in business, but until this assertion is supported by definite orders, it appears to be more a wish than a promise.

Steel.

So far as producers of heavy steel are concerned, it cannot be said that prospects are any better. The depression in industry, and shipbuilding in particular, shows but faint signs of dissipation. The stoppage of work on the new Cunarder was a severe blow, coming as it did when hopes of a revival in the industry were at last being entertained. A restart on that ship would be of some assistance, but until the state of trade all round justifies the building of a greater number of merchant vessels, there is little prospect of a revival in the demand for plates and sections to an extent necessary to establish a season of prosperity. With conditions so uncertain, it is difficult, if not quite impossible, to anticipate an improvement for some time to come. Sheet makers, on the other hand, have experienced considerable amelioration, and inquiries from abroad continue to display more animation. The lighter grades have been most in evidence, heavy grades being slow to improve. Galvanised descriptions, also, have a better market, but in many instances, prices have had to be keenly cut. Tubes have been quiet for some time, but it is expected that the completion of arrangements for the merging of the interests of Stewarts and Lloyds and the Scottish Tube Company may mark the commencement of better times for this industry.

Iron.

Apart from the reduction in the price of bar iron for home delivery, nothing of outstanding interest has been reported during the past two weeks. Inquiries generally are extremely moderate. It is said that competition from Staffordshire was largely responsible for the reduction in the price of Crown bar iron from £10 5s. to £9 15s. per ton. The export quotation remains at £9 5s. to £9 10s. per ton. Re-rolled steel bars are a dull market at £6 5s. home and £6 2s. 6d. per ton export. The number of pig iron furnaces in blast in Scotland remains at five, despite the elimination of Continental iron. Shipments from Glasgow last week amounted to 169 tons, of which 140 tons went abroad, compared with 623 tons—97 tons foreign—in the same week last year.

Coal.

Since the start of the year inquiries from abroad have been only moderate, and bookings have been limited. Meantime, Lanarkshire splints are well booked, and the collieries in Fifeshire and the Lothians are well sold for some time ahead. Prices, as a rule, are firm, though occasional weakness is apparent in the East of Scotland, owing to delay in arrivals of tonnage at the ports. Aggregate shipments amounted to 160,850 tons, against 187,061 tons in the preceding week and 162,993 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

LAST week was a very unsatisfactory period for collieries, particularly those producing steam qualities. According to the Great Western Railway Company's returns the total for the six ports under its control was 313,580 tons, whereas the shipments for the preceding week reached the total of 397,390 tons, which, however, was below the average. To make a comparison with the corresponding period of last year forms no criterion, as during the first fortnight of January, 1931, there was a strike of miners in this district. There is some excuse for shipments last week being disappointing, as, although chartering operations were not by any means unsatisfactory, the fact remains that the weather at sea was extremely bad and brought about a complete upset of arrangements. Tonnage failed to arrive in accordance with expectations, while, furthermore, the strike at the London Docks has further prevented tonnage moving round to anything like time. In the circumstances, numerous collieries were compelled to work short time owing to their supply of wagons running short and there was extremely little prompt business about to help collieries out of their difficulties. The demand, in fact, both for early loading and for delivery over a period, is quiet generally. The Palestine Railways are in the market for 12,000 to 14,000 tons of large Welsh steam coals, and there is reported to be an inquiry for 90,000 tons of bunker coals for Portugal; but, otherwise, there is no feature. On the contrary, what news does come to hand is for the most part adverse to the coal export trade. The report is current that the French surtax of 15 per cent. is not to apply to coking smalls as from the 18th inst., but licenses will still have to be secured. What, however, has created feelings of anxiety is the report which came to hand about the middle of last week that the Italian Government had imposed, as from January 1st, a landing tax on commodities discharged at Italian ports. These commodities include coal, and the tax is 2½ lire, equivalent to between 9d. and 10d. per ton. Extremely few details have been received concerning this order, and it is not known whether the impost applies to all coals, or whether coals for bunkering purposes, or for the Italian State Railways are exempted from the tax. Normally, this country supplies Italy with approximately 50 per cent. of her coal imports, and by far the largest percentage of British coals are despatched from South Wales, so that this district stands to suffer most. It is true that coals which go inland from Germany, Poland and France to Italy incur heavy railway charges, but the fact of the imposition of 2½ lire on coals going to Italy by sea cannot but be to the disadvantage of exporting countries like our own. The announcement is also made that the Italian Government has decided to subsidise her freight-carrying vessels during the current year, and the conclusion has, of course, been drawn that the imposition of the "landing tax" is to provide funds for that purpose. In some quarters that is denied, and it is stated that the "landing tax" is purely for revenue purposes; but whether that is so or not is not very material. The Mines Department is understood to be watching events very closely with a view to making representations to the Italian Government.

Tin-plate Items.

The report is current that an effort is being made to revive the tin-plate pool, which terminated at the end of June last. Preliminary discussions are taking place, but it is stated that unless the industry can depend upon an output of at least 70 per cent., the pool, which failed on account of the very poor demand for tin-plates, will be very difficult to work. Resumption of work at the Elba Works, Swansea, on Wednesday last week, did not mature, owing to a dispute with about a score of packers, but since then the differences with these men have been amicably arranged, and work was restarted on Monday of this week. It is expected that within a fortnight about 1000 workmen will have been re-employed.

Trade Returns for 1931.

Official returns of seaborne traffic at the six ports in South Wales controlled by the G.W.R. Company show that for 1931 imports and exports combined totalled 27,876,612 tons, which compares with 34,925,479 tons for 1930 and with 38,411,909 tons for 1929. Imports alone came to 3,968,858 tons, as against 4,811,234 tons in 1930 and 5,170,866 tons in 1929. Exports totalled 23,907,754 tons last year, compared with 30,114,245 tons in 1930 and 33,241,043 tons in 1929. Coal and coke shipments alone amounted to 21,747,464 tons, as against 27,386,050 tons in 1930 and 29,802,482 tons in 1929.

Tonnage Laid Up.

According to the returns of the Great Western Railway, the amount of tonnage laid up at South Wales ports is less than at any period since October, 1930, when the number of vessels was forty-three, of 257,600 tons deadweight. On January 1st, 1931, the number of vessels was sixty-seven, of 350,300 tons deadweight, and on October 1st the figures were seventy-four vessels of 398,342 tons; but, as the result of this country going off the gold standard, business temporarily improved and British tonnage was in a better position to compete with foreign-owned tonnage. Quite a number of steamers were therefore recommissioned, and on January 1st last the returns of tonnage laid up at South Wales ports showed that the number of vessels was fifty-seven, of 276,108 tons deadweight.

Coal-washing Plant.

A new coal-washing plant at the South Celynen Colliery, Newbridge, owned by the Ebbw Vale Company, was formally opened on Tuesday by Lady Beynon, wife of Sir John Beynon, Bart., who presided. This new plant is the largest automatically controlled plant in operation, and it is capable of handling 300 tons of coal per hour.

Current Business.

There has been no improvement in business in steam coals during the past week, and the conditions generally are very quiet. French orders have certainly become less and the demand from another of the principal customers of South Wales, viz., Italy, has become very quiet. Foreign buyers generally do not appear to be ready to operate, and it may be that the inclination abroad is to await developments regarding the German reparation question. The position of collieries has certainly been a very unenviable one of late, as, in addition to a scarcity of new business, tonnage fixed to load with them has been badly delayed and loading arrangements have been severely dislocated. At the end of last week the number of vacant berths at South Wales ports was thirty-four, and instead of the situation being improved on Monday, as the result of expected arrivals, the position was worse, as the number of vacant berths rose to thirty-six. Coal prices have not moved at all, and the tone all round is quiet. The demand for coke has slackened off, while patent fuel is no better. Pitwood is a quiet market on the basis of 23s. 6d. to 24s. for Portuguese wood and 24s. 6d. to 25s. for French wood.

The Quarter's Shipbuilding Returns.

FROM the statistics issued by Lloyd's Register of Shipping regarding vessels under construction at the end of December we note that in Great Britain and Ireland there was a decrease of 16,880 tons in the work in hand as compared with the figures for last September, and that the present total—400,505 tons—is 508,397 tons less than the tonnage which was being built at the end of December, 1930. Moreover, the figure for December, 1931, included about 154,000 tons on which work has been suspended. The total of 400,505 tons is the lowest recorded since September, 1887. Over 116,000 tons, representing 29 per cent. of the tonnage now in hand in this country, are intended for registration abroad or for sale.

The tonnage now under construction abroad, 1,003,290 tons, is about 110,000 tons less than the work which was in hand at the end of September, 1931. The five leading countries are:—United States of America, 207,837 tons; Italy, 178,287 tons; France, 164,440 tons; Germany, 103,981 tons; and Sweden, 95,380 tons. The total tonnage under construction in the world amounts to 1,403,795 tons, of which 28½ per cent. is being built in Great Britain and Ireland, and 71½ per cent. abroad.

In Great Britain and Ireland, 104,784 tons were begun during the last three months of the year—an increase of 66,109 tons over the corresponding figures for the September quarter. The increased figures, however, were still much below the quarterly average reached during recent years. In this connection, it may be stated that during the six months ended March, 1930, the monthly average of tonnage begun was over 154,000 tons. During the fourth quarter of 1931 70,707 tons were launched, a decrease of about 10,000 tons as compared with the quarter ended September 30th last. Similar figures for abroad were 120,698 tons begun, and 230,971 tons launched, these figures showing decreases, as compared with the previous quarter, of 13,987 tons in the tonnage begun and of 75,297 tons in the tonnage launched.

The oil tankers under construction in the world amount to forty-five vessels of 351,320 tons, of which ten vessels of 65,441 tons are being built in Great Britain and Ireland, twelve vessels of 83,400 tons in Sweden, and six of 72,400 tons in Germany. It is noteworthy that of the forty-five tankers under construction, forty-one are motor ships, and that the four steam tankers are all being built in Great Britain. The tanker tonnage now in hand represents 25 per cent. of the total steam and motor tonnage being built in the world.

During the first three quarters of 1930 the tonnage of motor ships under construction in Great Britain and Ireland exceeded that of steamers being built, but since the beginning of 1931, steam tonnage has again exceeded motor ship tonnage, the excess at the end of December last, amounting to 220,000 tons. The motor ship tonnage being constructed abroad—540,228 tons—is still 78,647 tons greater than that of the steamers. Of the vessels being built in the world at the end of December, there are five steamers and thirty motor ships of between 8000 and 15,000 tons; five steamers and five motor ships of between 15,000 and 30,000 tons; and six steamers and no motor ships of 30,000 tons and upwards.

The table respecting marine engines shows that the horse-power of steam engines being built or being fitted on board amounts to about 1,100,000, while the figures for oil engines aggregate about 513,000. The figures for steam engines include thirty-seven sets of turbine engines of about 952,000 shaft horse-power, giving an average of nearly 25,750 horse-power per set. The capacity of the steam reciprocating engines—148,180 horse-power—is less than 9¹/₅ per cent. of the total horse-power of marine engines now being built in the world.

Notwithstanding the great reduction which has taken place in the amount of work in hand, the tonnage in course of construction throughout the world under the inspection of Lloyd's Register reaches 815,019 tons; of this total, 360,350 tons are being built in Great Britain and Ireland and 454,669 tons abroad.

CONTRACTS.

HICK, HARGREAVES AND CO., Ltd., of Bolton, have received orders for the supply of evaporating plant for the 1930 extensions to the Barking power station of the County of London Electric Supply Company, Ltd., and for the 1931 extensions to the Vereeniging station of the Victoria Falls and Transvaal Power Company, Ltd.

ROBERT STEPHENSON AND CO., Ltd., of London and Darlington, have received an order from the Ottoman Railway from Smyrna to Aidin for two locomotives and tenders. The locomotives are to be of the 2–8–2 type, with cylinders 19½in. by 26in. and with coupled wheels 5ft. 2in. diameter, the tractive force being 23,042 lb. They are to be fitted with multiple-valve regulators and superheater headers by the Superheater Company, as well as with "Titan" feed-water heaters and purifiers in the domes.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL CO., Ltd., has received orders from the Southern Railway for the supply of material for the new signalling installation on the Brighton line. The materials, which will include 3 all-electric locking frames aggregating 225 levers, 2 illuminated diagrams, 115 point machines, 136 three-position indication relays, 86 globe type shunt signals, 51 three-aspect colour light signals, 116 single-rail track feed sets, 144 two-position track relays, 463 single-element line relays, 56 impedance bonds, 22 optical route indicators, and two 10-kW rectifiers.

CATALOGUES.

G. AND J. WEIR, Ltd., Cathcart, Glasgow.—Publication No. 35, "Feeding the Modern Boiler."

ALFRED HERBERT, Ltd., Coventry.—"Auto-lathes Operators' Handbook," third edition, and "Capstan-lathes Operators' Handbook" sixth edition.

MOSERS, Ltd., 4, Marshalsea-road, London, S.E. 1.—A twenty-page brochure showing some of the British-made tools and products handled by the firm.

BRITISH STEEL PILING COMPANY, Ltd., 54A, Parliament-street, S.W. 1.—Particulars of the 14/10 "Wonder" concrete mixer and the "Epic" mobile crane.

G. D. PETERS AND CO., Ltd., 3, Central-buildings, S.W. 1.—Catalogue of "Wilson" plastic arc-welding plants and "Colour-tipt" welding metals.

RECENT DEVELOPMENTS IN THE MANUFACTURE OF WELDED STRUCTURES.—In a paper on this subject, read before the Manchester Association of Engineers on Friday, 8th inst., by Mr. L. Miller, A.M.I.E.E., the author dealt with the matter under the following headings:—(1) Reduction in cost to be obtained by welded construction; (2) the design of welded structures; (3) training of the welder; (4) development of apparatus; (5) welding technique; and (6) examples illustrating the subject. Mr. Miller said that the field of application for welding was spreading every day, and that the firm with which he is associated employed seventy-nine welders and seventy-nine welding machines, with a shop area of 59,000 square feet. With regard to the design of welded structures, the author said that the designer and the drawing-office had played their part in the development of welding and had advanced a long way in the technique of designing welded structures. The development of standard joints had also helped in the simplification of the work. The fabricated or welded structure removed many limitations imposed on the designer by the use of such materials as cast iron and steel. Designs could be modified and changed without annoying or expensive delays, while for experimental and development work the welded structure was invaluable. The interest in the paper was enhanced by a number of slides showing welded structures, including a 62,500-kVA turbo-alternator stator made for the Bristol Corporation. The author said that machines of that type had been constructed up to 20ft. in length by the welding process. The paper was followed by an interesting discussion.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/– to 19/6
(1) Spanish	17/– to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	16/6 to 17/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 5 0	3 5 0
No. 1	3 5 6	3 5 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*)	—
	4 0 6 (*b*)	—
	4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.	10 5 0	9 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 15 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 15 0 to 8 0 0	—
Small Re-rolled Bars	6 17 6 to 7 0 0	—
Billets and Sheet Bars	5 7 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 0 0 to 9 2 6	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 12 6	—

NON-FERROUS METALS.

SWANSEA—		
Tin-plates, I.C., 20 by 14	f.o.b.	14/– to 14/6
Block Tin (cash)		142 12 6
„ (thre months)		145 15 0
Copper (cash)		42 15 0
„ (three months)		42 10 0
Spanish Lead (cash)		15 12 6
„ „ (three months)		15 13 6
Spelter (cash)		14 13 9
„ (three months)		15 3 6
MANCHESTER—		
Copper, Best Selected Ingots		46 0 0
„ Electrolytic		50 0 0
„ Strong Sheets		77 0 0
„ Tubes (Basis Price), lb.		0 0 11
Brass Tubes (Basis Price), lb.		0 0 10
„ Condenser, lb.		0 1 0½
Lead, English		17 2 6
„ Foreign		15 15 0
Spelter		14 17 6
Aluminium (per ton—raw ingot)		£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/4 per lb.	
Ferro Tungsten	2/– per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 12 6	7/–
„ „ 6 p.c. to 8 p.c.	£23 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£22 10 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 0 0	10/–
„ „ „ 1 p.c. carbon	£40 0 0	12 –
„ „ „ 0·70 p.c. carbon	£51 0 0	13/–
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£9 10 0 scale 5/– per unit	
„ „ 75 p.c.	£15 0 0 scale 7/– per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/9
„ „ Ell	14/6
„ „ Splint	14/3 to 15/9
„ „ Trebles	16/–
„ „ Doubles	13/6
„ „ Singles	10/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/–
„ „ Trebles	16/–
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 13/9
Screened Navigation	17/–
Trebles	16/–
Doubles	13/6
Singles	10/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/6 to 12/9
Secondary Steam	12/3
Trebles	15/6 to 16/–
Doubles	13/6
Singles	10/9
ENGLAND.	
(8) N.W. COAST—	
Steams	21/9
Household	32/6 to 51/8
Coke	20/– to 21/–
NORTHUMBERLAND—	
Best Steams	13/9 to 14/–
Second Steams	12/– to 12/6
Steam Smalls	8/6 to 9/–
Unscreened	12/6 to 13/–
Household	27/– to 39/–
DURHAM—	
Best Gas	14/6 to 14/9
Second	13/6
Household	25/– to 37/–
Foundry Coke	24/–
SHEFFIELD—	Inland.
Best Hand-picked Branch	26/– to 27/– —
South Yorkshire Best	24/– to 25/– —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	22/– to 23/– —
Screened House Coal	19/– to 20/6 —
Best Screened Nuts	17/– to 18/– —
Small Screened Nuts	15/6 to 16/6 —
Yorkshire Hards	17/– to 18/6 —
Derbyshire Hards	17/– to 18/6 —
Rough Slacks	9/– to 10/– —
Nutty Slacks	8/– to 9/– —
Smalls	5/6 to 6/6 —
Blast-furnace Coke (Inland)	11/– to 12/6 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 17/– to 18/–	
(9) SOUTH WALES.	
CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	19/– to 27/–
No. 3 Rhondda Large	19/9 to 20/–
„ „ Smalls	15/– to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	15/6 to 16/–
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	22/– to 26/6
Furnace Coke (Export)	17/– to 18/–
Patent Fuel	19/– to 19/6
Pitwood (ex ship)	23/6 to 24/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/– to 38/6
Seconds	27/– to 32/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/– to 48/6
Beans	28/6 to 32/6
Peas	19/– to 21/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/3 to 8/9
Steam Coals :	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate; Joists (minimum), 22/6

Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Wages and Costs.

In the metallurgical industries in the Nord wages have been reduced, and the movement in favour of wages' reductions is becoming general. It is usually accepted without friction by the men, who prefer a lower remuneration for their labour to the alternative of having no work at all. Wages cannot be maintained in this country when they are declining all over the Continent, and when manufacturers are burdened with stocks which they are anxious to dispose of on almost any terms. These accumulations of stocks and forced sales are creating a lower level of values and, so long as the present state of things continues, works can only be kept in partial operation by further economies in production costs. So far the only resistance to a reduction of wages met with is from the colliers in the Nord and the Pas de Calais, who have been advised that the present wages agreement will terminate at the end of the month. The Coalowners' Association affirms that it has not secured the share of the home trade which was promised to it when the import quota system was put into operation, and that, with the fall of the pound, the reduction of wages in Belgium and the subsidies paid on Polish coal for export, its members cannot compete in price unless they are able to reduce their costs. Seeing that the original quota was based upon the normal French consumption of coal, the unsatisfactory situation of coal-owners can only be attributed to the contraction of demand for industrial fuel, and as the industrial requirements continue to decline the miners are likely to find that they can only maintain their wages by a total exclusion of foreign coal. The Prime Minister has already informed them that the Government has gone as far as possible in the way of restricting coal imports. The interests of industrial consumers must be taken into account, and they cannot be required to pay considerably more for their coal than foreign consumers who compete with them.

African Lorry Trials.

The motor lorry is regarded by some as a competitor of the proposed railway across the Sahara Desert and by others as an auxiliary of the railway. It is already in service in desert regions to the south of Algeria, and there are occasional services across the desert to Gao on the Niger; but, while the difficulties of travelling over the sandy routes are said to have been overcome by the use of endless track and six-wheeled vehicles, there is the further problem of using a less volatile fuel than petrol, which is uneconomical in those hot territories. It has therefore been decided to organise a trial of lorries and other vehicles with engines running on heavy oils. Starting from Algiers next month, a run will be made to Gao and back, a total distance of 3800 miles. Following the existing desert route by way of El Golea, Adrar, Reggan and Tessalit, the daily journeys will not exceed 218 miles, and those vehicles that fail to attain an average of 12 miles an hour to El Golea will be eliminated from the competition. During the past year there were demonstrations of lorries and omnibuses in connection with the national fuel congress in Paris, and some of them had solid injection engines that gave quite satisfactory results, so that there is certain to be a fair number of vehicles taking part in the Sahara competition. The arrangements are in the hands of the military authorities.

South American Air Service.

Amongst the questions discussed by the Franco-German Commercial Commission is the possibility of co-operation between the two countries for the air service to South America. The service was initiated by Monsieur Latécoère, the aircraft builder, who created a line between Toulouse and North Africa, which was subsequently extended to Dakar, with fast boats to Natal in Brazil, and air lines from that port to different parts of South America. Conditional transport monopolies were obtained from South American Governments, and the Compagnie Aeropostale was formed to work them and complete the service with seaplanes across the South Atlantic. The financial collapse of the Aeropostale, which was saved from bankruptcy by State intervention and a reorganisation under State control, threatened disaster to this big scheme, and it seemed to be further compromised last year by the successful journeys of the Zeppelin airship between Europe and South America. Meanwhile neither the French nor the Germans have succeeded in providing seaplanes for an economical and reliable service across the South Atlantic. Therefore, as the problem appears to offer exceptional difficulties, the co-operation of Dr. Eckener and the Luft Hansa with the French is being examined by the Franco-German Commercial Commission, the idea at present being that the Zeppelin Company should effect the service with airships between Dakar and Pernambuco, pending the construction of suitable seaplanes, and that the Compagnie Aeropostale should work the lines in South America. It is, however, affirmed that the conditions in the South Atlantic are not favourable to airships between the months of April and September, and the French regard it as doubtful whether such a service can be maintained all the year round.

The Bordeaux Sea Port.

In view of the progress being made with the construction of the mole at Le Verdon, at the mouth of the Gironde, it is expected that the ocean port of call for Bordeaux, which is 60 miles up the river, will be completely finished in the spring of next year. The mole, with its landing stage and station, is being connected with the mainland by a railway viaduct, and the whole will be carried on ninety-six reinforced concrete piers, eighty-six of which have already been constructed. At low tide there is 10·5 m. of water, so that South American and Transatlantic steamers will be able to call at all times and in all weathers. Similar works are being undertaken at La Pallice with the idea of making La Rochelle-La Pallice a port of transit to Paris and Central Europe.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

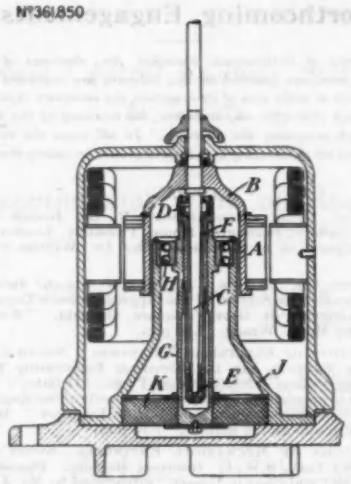
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

361,850. August 21st, 1930.—HIGH-SPEED ELECTRIC MOTORS, Allgemeine Elektricitäts-Gesellschaft, of Friedrich Karl-Ufer 2/4, Berlin, N.W. 40.

This invention relates to high-speed electric motors with vertical shafts in which difficulties are liable to arise because of movements of the shaft in addition to the simple rotation. The rotor core A is mounted upon a carrier B, which is carried on the shaft C. The latter tapers downwards conically, and is mounted in a roller bearing D and a footstep bearing E. In order to provide a small central air gap and to avoid the reduction of this gap below the smallest allowable value practical on mechanical grounds, the rotor core surface may be made barrel-shaped. The stator core surface or both core surfaces may,

N°361,850

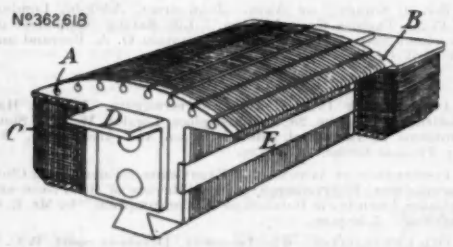


of course, also be made barrel-shaped. The bearings are placed in a sleeve F, which rests in an outer sleeve G, formed as an oil container. The outer sleeve is mounted by means of a self-aligning ball bearing H at the geometrical centre of the rotor or at a point lying close to it. The bearing H is carried by a part J, which is fastened firmly between the stator casing and the base plate, and is surrounded in bell fashion by the rotor core carrier B. The sleeve G is resiliently supported at its lower end by a rubber buffer K, which is in contact with the part J and the base plate. The lower bearing E is under oil, which is admitted from the outer sleeve and rises from the lower to the upper bearing in accordance with the peripheral velocity of the conical shaft.—*November 23rd*, 1931.

362,618. November 7th, 1930.—SYNCHRONOUS MOTORS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

The object of this invention is to provide an improved rotor construction for synchronous motors of the salient pole type having starting windings embodying the segmental or open end ring principle wherein the tendency of the rotor to "crawl" or "stick" at about half-speed is practically eliminated. The face of each individual pole is provided with the squirrel-cage bars A of a material such as copper, these bars being connected at their opposite ends to the end segments or punchings B, also of copper. For the purpose of retaining the field coil C in proper position, retaining lugs or flanges D are secured to the opposite ends of the pole. In the construction so far described there is no satisfactory electrical connection between the bars A of adjacent poles. The currents induced in the poles when the rotating flux is in the interpolar space must, therefore, take a comparatively long circuit comprising the length of the path between adjacent poles. The resulting higher impedance of the squirrel-cage construction would cause the rotor to "crawl"

N°362,618



at about half-speed. Furthermore, the comparatively high voltages induced in each group of squirrel-cage bars due to the linking of the bars as a unit by the cross axis flux would cause objectionable sparking during the starting period of the motor. For the purpose of eliminating these disadvantages each pole is provided with an electrical connection, such as a bar E, of material such as copper, extending longitudinally along a side of the pole beneath the pole tips and electrically connecting the end punchings B. The currents induced in the squirrel-cage bars A by the rotating flux during the starting period, consequently, do not need to flow through the bars of the adjacent pole, or through part of the bars of the same pole to complete the circuit, but are provided with a closed circuit through the connection E so that the impedance of the circuit is not appreciably greater along the cross axis than along the main axis. This bridging connection, linking substantially all of the cross axis flux, therefore serves to lower the impedance with respect to the cross axis in a manner well known in the art. There will therefore be very little tendency on the part of the rotor to "crawl" at half-speed, and the rotor will be brought up to synchronous speed more readily. Moreover, the tendency toward sparking during the starting period is overcome owing to the fact that the cross axis flux is opposed by currents induced in the squirrel-cage bars.—*December 10th*, 1931.

SWITCHGEAR.

361,985. July 3rd, 1930.—ARC-RUPTURING ARRANGEMENTS FOR ELECTRIC CIRCUIT BREAKERS, Etablissements Merlin et Gerin Société Anonyme, of Rue du Monestier de Clermont, Grenoble, France.

A method is described in this specification of splitting up the arc produced in a circuit breaker into a large number of small arcs in series or in series-parallel. The break chamber A is filled with parallel rods B spaced apart and insulated from one another and arranged preferably in concentric circles. Neighbouring rods of two adjacent circles are on the same radius, or

N°361,985

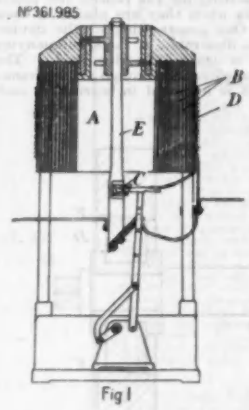


Fig 1

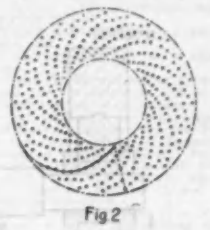


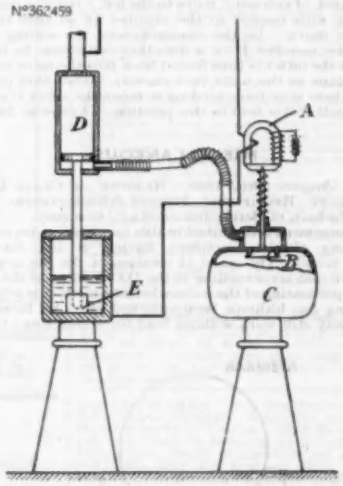
Fig 2

displaced a definite amount in relation to each other, as shown in Fig. 2. The arc occurs between the two sparking contacts C, which are outside the chamber, and their movement causes the insertion of the solenoid D in the main circuit. The arc which bridges the two sparking contacts commences to wind round the central tube E under the influence of the axial component of the stray field of the solenoid field, and as soon as it has assumed a certain development it is drawn violently to the interior of the break chamber through the influence of the component which is perpendicular to the axis of this field.—*December 3rd*, 1931.

362,459. September 4th, 1930.—MEANS FOR REDUCING THE SWITCHING-OFF TIME OF POWER SWITCHES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

In the coupling of power stations which operate in parallel on supply mains, it is of the greatest importance, on the occurrence of a short circuit in one line, to cut out the defective line section in the shortest possible time, as with a short circuit of long dura-

N°362,459



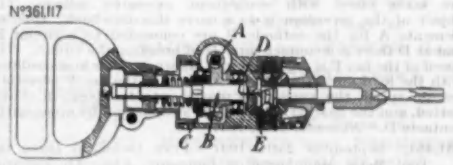
tion the synchronism of the power stations may be so disturbed that these power stations fall out of step. Consequently, the switching-off time of the power switches by means of which the switching out of defective lines takes place must be reduced to a minimum. In accordance with this invention the excess current demagnetises the core A when a valve B admits air under pressure to the cylinder D from the vessel C. The pressure thus acts on the piston in the cylinder D and opens the contacts E.—*December 4th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

361,117. November 21st, 1930.—SCREW-CUTTING TOOLS, Société Industrielle d'Appareillages Mécaniques et Electriques, 74, rue Saint-Maur, Paris.

The idea of this invention appears to be the provision of a power-driven tool for tapping threads, which will drive forward for the cutting action and reverse for the retraction of the tap at the will of the operator in pushing in or pulling out the tool.

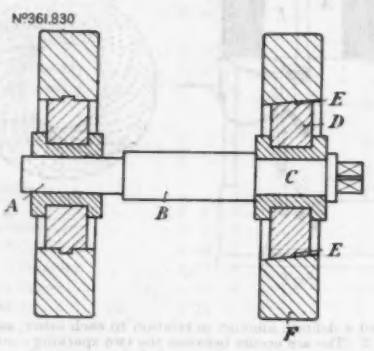
N°361,117



The drive is supplied by a flexible shaft to the worm A and is transmitted to the spindle B through the slipping clutch C. When the tap is pressed into the work the tenons D engage with corresponding crevices in the end of the spindle B and give a direct drive. When any effort is made to withdraw the tap the tenons come out of engagement and the mitre gearing E reverses the direction of rotation of the tap.—*November 21st*, 1931.

361,830. September 11th, 1931.—ROLLING MILLS, Demag Aktiengesellschaft, Duisburg, Germany.

In rolling mills it is, according to the inventors, often the case owing to inexact setting or other causes, that the axes of the rollers do not lie in the same vertical plane. The consequence is that, when the rollers are in operation, they are forced in the axial direction, which affects the bearings and the various parts, which quickly become worn. Thus, there is not only a loss of power, but the dimensions of the metal being rolled are affected. To overcome these difficulties, steps are generally taken to set the bearings supporting the rollers horizontally, so that the rollers lie in the same vertical plane. While it is a fairly simple matter to align the rollers of two-high rolling mills in the manner described, to align rolling mills having three or more rollers requires very great care and much labour. According to the invention the rollers are aligned by such an axially movable setting of one or both roller journal bearings that the bearing or bearings is, or are, automatically moved into position to give the desired setting for the rollers, the rollers being moved axially as occurs when they are placed in their bearings during operation. One construction of the device, according to the invention, is illustrated in the accompanying drawing, and its operation is hereinafter described. The drawing is a horizontal sectional elevation through a roller frame. The journal A of the roller B is mounted in bearings in such

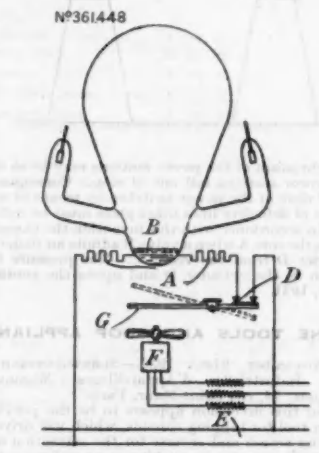


manner that the roller is allowed to move a certain distance axially. The other journal C is so mounted that if the roller should move axially the member D must move with it. The member D has sloping end faces E, which slide along correspondingly sloping faces of the roller frame F. When the clockwise-driven roller B is in a sloping position, for example, rising from left to right, with respect to the drawing, the frictional force is exerted between the roller B and the roller below it, and acts in a direction at right angles to the axis of the roller B—that is, in the opposite direction to the direction of movement of the roller on the line of contact. This frictional force may be divided into two component forces, one of which acts in a direction normal to the axis of the roller not shown, while the other acts in a direction parallel to the axis of this roller. This frictional force acts separately on the roller B with one component parallel to the axis of the roller B, which is directed towards the left with reference to the drawing. The roller B, being able to move axially, must, of necessity, move to the left; but it is not capable of moving with respect to the member D, so that the latter must also move. In the circumstances the sliding surfaces E force the member D in a direction transverse to the roller B, so that the latter is thus forced back into the same imaginary vertical plane as the roller (not shown). When that position is reached, there is no force tending to move the roller B axially so that the roller B is held in this position.—*November 26th*, 1931.

MISCELLANEOUS.

361,448. August 29th, 1930.—HEATING OF GLASS ELECTRIC CURRENT RECTIFIERS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

An arrangement is described in this specification for regulating the heating of glass rectifiers, having a fan for cooling the glass vessel. The speed of rotation of the fan is regulated in a known manner according to the D.C. loading of the rectifier. After the preheating of the bulb, when the rectifier is switched in, the heating has hitherto been switched off. As, however, the rectifier may still work without load for a long time, the vessel



may so cool off during that period that breaking of the arc takes place, with consequent excessive voltage. The object of the invention is to remove this drawback. Heating elements A for the cathode B are connected to a circuit E, and at D there is a contact capable of breaking the circuit. The speed of the fan F is regulated in a known manner in accordance with the load on the rectifier. As soon as the fan F exceeds a certain speed, the vane G is moved into the position shown dotted, and the heating elements are switched off by opening the contacts D.—*November 26th*, 1931.

361,831. September 25th, 1931.—FINE DRAWING DIES, the Tool Metal Manufacturing Company, Ltd., 11, Victoria street, London, S.W. 1.

This invention relates to fine drawing dies of the kind consisting of a piece of the so-called hard metal, such as that sold under the registered trade mark "Widia," inserted into a holder. It is usual in the manufacture of such fine drawing dies to press the hard metal insert into a holder of brass or unalloyed steel while hot, but those metals have a much greater coefficient of expansion than hard metal. As a result, owing to the unequal shrinkage of the hard metal and the material of the holder, stresses arise which often lead to the occurrence of cracks in the hard metal insert, either immediately or during use. The invention aims at producing hard metal fine drawing dies in which the hard metal insert is free from stress. The object is attained by embracing the hard metal insert in a holder of which at least that part in contact with the hard metal insert is made from a material which has the same, or, at least, approximately the same, coefficient of expansion as the hard metal. The result is that the holder and insert shrink uniformly, and, therefore, no stresses arise. With inserts made from the known hard metals, which consist mainly of tungsten carbide and have a coefficient of expansion of about 5×10^{-6} per deg. Cent., nickel steels containing about 39 to 45 per cent. nickel, have been found to be suitable. The use of nickel steels in comparison with the use of unalloyed steels has the further advantage that the holder is more capable of resisting the pickling materials used in the wire drawing. In order to increase the resistance to corrosion, a part of the nickel may be replaced by alloy constituents, which improve the resistance to corrosion, such, for example, as chromium, tungsten, molybdenum and so forth. The use of a steel holder in comparison with the use of one made of brass or bronze also has the advantage that the hard metal insert can be soldered in. Instead of manufacturing the whole holder of a material with a coefficient of expansion substantially equal to that of the hard metal insert used, the hard metal insert may be surrounded or embraced by a piece of foil of a material with a corresponding coefficient of expansion and then, for example, soldered into a holder of chromium steel or chromium nickel steel of high resistance to corrosion, the coefficient of expansion of which is different from that of the hard metal.—*November 26th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

CHEMICAL ENGINEERING GROUP.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, London, W. 1. "The Preparation of Emulsions," by Dr. William Clayton. 8 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Stresses in Metals," by Mr. A. Wragg. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—In the Electrical Engineering Theatre, Armstrong College, Newcastle-on-Tyne. Debate. Mr. J. Bennett will propose "That it is to the Benefit of the Engineering Industry that the Salesman should be an Engineer." Mr. S. G. Hambly will oppose the motion. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, St. James's Park, S.W. 1. Informal Meeting. Discussion on "Industrial Conditions in Russia," introduced by Mr. J. Fearn. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Development of the Loud Speaker," by Mr. H. J. N. Riddle. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Lecture Theatre of the Mining Institute, Newcastle-on-Tyne. "Rivets and their Significance in Shipbuilding," by Mr. Robert Boardman. 6 p.m.

PHYSICAL SOCIETY.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. Meeting 5 p.m. Editing Committee meeting 3.30 p.m. Council meeting 4 p.m.

TO-DAY TO SATURDAY, JANUARY 23RD.

MODELS EXHIBITION AND PAGEANT OF POSTAGE STAMPS.—Dorland Hall, London, S.W. 1. 10.30 a.m. daily.

SATURDAY, JANUARY 16TH.

HULL ASSOCIATION OF ENGINEERS.—Municipal Technical College, Park-street, Hull. "The Application of Gearing," by Mr. H. E. Merritt. 7.15 p.m.

MONDAY, JANUARY 18TH.

BRADFORD ENGINEERING SOCIETY.—In the Hall of the Bradford Technical College. "A Brief History of Electrical Development," illustrated by lantern slides, by Mr. G. S. Francis. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Epicyclic Gearing," by Major W. G. Wilson. 7.30 p.m.

INSTITUTION OF SANITARY ENGINEERS.—Caxton Hall, Westminster, S.W. 1. Presidential address by Mr. Henry C. Adams. 7 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Thomas Gray Lecture, "Life Saving Appliances on Merchant Ships" (Lecture I.), by Captain O. A. Barrand and Mr. G. A. Green. 8 p.m.

TUESDAY, JANUARY 19TH.

INSTITUTE OF INDUSTRIAL ADMINISTRATION.—Lecture Hall Institute of Hygiene, 28, Portland-place, London, W. 1. "Some Problems of Industrial Administration and Accounting," by Mr. Thomas Keens. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineering Club, Queen-street, Wolverhampton. "A Review of the Piston and Cylinder Assembly in Relation to Oil Consumption," by Mr. E. C. Ottaway. 7.30 p.m.

OLD CENTRALIANS.—The Devereux, Devereux-court, W.C. 2. Luncheon. Speaker, Professor W. A. Bone, F.R.S., on "Low-temperature Carbonisation." 1 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. "Physical Metallurgy," by Mr. C. A. Edwards. 5.15 p.m.

SHEFFIELD METALLURGICAL SOCIETY.—195, West-street, Sheffield. "Pressed Steel in the Automobile Industry," by Mr. J. C. Arrowsmith. 7.30 p.m.

THE INSTITUTION OF WELDING ENGINEERS: NORTH-WESTERN BRANCH.—The College of Technology, Manchester. "Welding of Aeroplane Parts," by Mr. P. F. Taylor. 7.30 p.m.

WEDNESDAY, JANUARY 20TH.

INSTITUTION OF CHEMICAL ENGINEERS.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, London, W. 1. "The Production of Hydrogen and Oxygen by Electrolysis at High Pressures," by Dr. D. M. Newitt and Dr. H. K. Sen. 6 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: BIRMINGHAM CENTRE.—Room 178, Queen's Hotel, Birmingham. "Roads and the Road Roller," by Mr. C. G. Miller. 6.45 p.m.

INSTITUTION OF MINING ENGINEERS.—In the Rooms of the Geological Society, Burlington House, Piccadilly, London, W. 1. Annual general meeting. Discussion, "A New Respiratory Apparatus for Use in Mines," by Professor Henry Briggs; "Some Photometric Comparisons of the Illuminations Produced by Different Lighting Arrangements Underground," by Mr. E. J. Kimmins; "The Candle-powers of Safety Lamps Before and After Underground Shifts," by Dr. T. David Jones and Mr. C. E. Morgan; "Comparative Photometric Tests of Miners' Electric Hand Lamps," by Professor W. H. McMillan; "The Flame Safety Lamp: The Use of Reflectors," by Professor R. V. Wheeler and Mr. D. W. Woodhead; "Roof Control in the Arley Seam, 'No. 1' Pit," by Mr. Richard Faulkner; "Third Progress Report of the Committee of the Midland Institute of Mining Engineers on the Control of Roof and Support of Mine Workings: 'The Support of Underground Roads by Steel Arches.'" 11 a.m. 1 p.m., the meeting will be adjourned. 2.15 p.m., the meeting will be resumed and will be concluded at or about 4.15 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: GRADUATE SECTION.—Bolbec Hall, Newcastle-on-Tyne. "Some Problems in Ship Repairing," by Mr. A. T. S. Sheffer.

ROYAL METEOROLOGICAL SOCIETY.—46, Cromwell-road, South Kensington, S.W. 7. Meeting at 7.30 p.m.

ROYAL MICROSCOPICAL SOCIETY.—B.M.A. House, Tavistock-square, W.C. 1. Presidential address by Professor R. Ruggles Gates, F.R.S. 5.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Some Aspects of the Problem of Industrial and Commercial Waste," by Mr. J. L. Hodgson. 8 p.m.

SOCIETY OF GLASS TECHNOLOGY.—In the Reynolds Hall, College of Technology, Sackville-street, Manchester. A selection from the following papers will be presented:—"Notes on the Method of Determining the Viscosity of Molten Glass," by Captain A. R. Wood; "The Transmission of Soda-lime-silica Glasses Containing Ferrous Oxide," by Dr. D. Starkie and Professor W. E. S. Turner; "The Dissociation of Lithium Carbonate and Potassium Carbonate," by Dr. J. T. Howarth and Professor W. E. S. Turner; "Some Further Experiments on the Rate of Decomposition of Calcium Carbonate," by Mr. W. Maskill and Professor W. E. S. Turner; "A Study of the Factors which Influence the Surface Durability of Glass Containers," by Mr. H. S. Blackmore, Miss V. Dimbleby, Mr. R. W. Howes, Mr. W. J. A. Warren, and Professor W. E. S. Turner. 2.15 p.m.

THURSDAY, JANUARY 21ST.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "Electric Welding of Non-ferrous Alloys," by Dr. A. Burstall. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. "The Absolute Measurement of High Electrical Pressures," by Professor W. M. Thornton and Mr. W. G. Thompson. 6 p.m.

INSTITUTION OF MINING AND METALLURGY.—At the Rooms of the Geological Society, Burlington House, Piccadilly, London, W. 1. Discussion, "Driving a Mines Drainage Tunnel in North Wales," by Mr. J. L. Francis and Mr. J. C. Allan. 5.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—Hotel Metropole, Leeds. "The Employment of Structural Engineers as Specialists," by Mr. W. T. Cresswell. 7 p.m.

INSTITUTION OF WELDING ENGINEERS.—At the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, London, S.W. 1. "Nickel and its Non-ferrous Alloys, with Special Reference to Welding," by Mr. J. McNeil. 7.45 p.m.

FRIDAY, JANUARY 22ND.

BRITISH INDUSTRIAL PURCHASING OFFICERS' ASSOCIATION.—At Hotel Rubens, Buckingham Palace-road, S.W. 1. "The Value of a Centralised Purchasing Department," by Mr. J. McDowell. 6 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Hotel Metropole, Leeds. "Progressive Methods Applied to a Modern Shop for Electric Rolling Stock," by Colonel E. Graham. 7.15 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Notes on Hydraulic Installations in New Zealand," by Mr. H. S. Lamburd. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Lecture Theatre, Literary and Philosophical Society, Newcastle-upon-Tyne. Further discussion, "Improved Marine Steam Reciprocating Engines: Does their Performance Justify their Extra Cost?" 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Discourse, "The Expanding Universe," by Sir Arthur Eddington, F.R.S. 9 p.m.

SATURDAY, JANUARY 23RD.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND STUDENTS' SECTION.—Visit to British Broadcasting Corporation, Moorside Edge Station, near Huddersfield. Meet 2 p.m. at General Post Office, City-square, Leeds.

MONDAY, JANUARY 25TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. Thomas Gray Lecture, "Life Saving Appliances on Merchant Ships" (Lecture II.), by Captain O. A. Barrand and Mr. G. A. Green. 8 p.m.

TUESDAY, JANUARY 26TH.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Station Hotel, Edinburgh. "Coal Ignition Systems," by Mr. E. A. Watson. 7 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C. 2. "The Air Resistance of Ships' Hulls and Superstructures," by Mr. G. Hughes. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Empire Timbers," by Major J. R. Cosgrave. 4.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—195, West-street, Sheffield. "Tests of Aircraft Materials and Components," by Mr. J. G. Gerrard. 7.30 p.m.

WEDNESDAY, JANUARY 27TH.

BRITISH WOOD PRESERVING ASSOCIATION.—In the Lecture Hall, Auctioneers' and Estate Agents' Institute, 29, Lincoln's Inn-fields, London, W.C. 2. "Diseases of Timber," by Mr. K. St. G. Cartwright. 6 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Metropole Hotel, King-street, Leeds. "A Review of the Piston and Cylinder Assembly in Relation to Oil Consumption," by Mr. E. C. Ottaway. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineers' Club, Manchester. "Transmission," by Mr. L. H. Pomeroy. 7 p.m.

By arrangement with Reuter's Engineering Service, THE ENGINEER *contains the latest news from all parts of the world which is likely to be of interest to engineers.*